Final Report

Subsurface Investigation
Former Griffin Wheel Brass Foundry
South Tacoma Field Superfund Site
Tacoma, Washington

Amsted Industries
Chicago, Illinois

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December 1992

Kennedy/Jenks Consultants

SUBSURFACE INVESTIGATION
FORMER GRIFFIN WHEEL BRASS FOUNDRY
South Tacoma Field Superfund Site
Tacoma, Washington

FINAL REPORT

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1.0 INTRODUCTION

1.1 INTRODUCTION AND SUMMARY

This report presents the results of the subsurface investigation performed at Amsted Industries' Former Brass Foundry (Griffin Wheel Brass Foundry) at the South Tacoma Field Superfund site (STF) to characterize the occurrence of free-phase petroleum product in the vicinity of MW-2. A site location map (Figure 1) is included in Appendix A. The report also presents a review of remedial alternatives and recommendations to address the conditions identified by the investigation. The subsurface investigation and remedial alternatives review were performed pursuant to the requirements of the work plan entitled *Well Installation and Monitoring Former Griffin Wheel Brass Foundry - Tacoma, Washington*, February 1992 by Kennedy/Jenks Consultants (Work Plan). This Work Plan presented the objectives and technical approach for conducting this investigation. The first principal technical objective was to evaluate the lateral extent of petroleum present in soil and groundwater in the vicinity of the former location of several underground storage tanks (USTs). The second principal technical objective was to determine if the petroleum poses or is likely to pose a threat to human health or the environment. Field work completed under the Work Plan included installation, monitoring, and sampling of seven resource protection (monitoring) wells. This report presents the data, observations, evaluations, and conclusions based on the field investigation and provides recommendations for the next phase of work.

1.2 BACKGROUND

As discussed in the *Remedial Investigation/Risk Assessment/Feasibility Study, Former Brass Foundry Area, South Tacoma Swamp* prepared for TIP Management/Amsted Industries by Kennedy/Jenks/Chilton in 1987, elevated

concentrations of petroleum hydrocarbons were noted in soil samples collected during boring of MW-2. This well was installed in September 1986, immediately adjacent to the USTs located north of the foundry. Reportedly, these USTs were used to store bunker oil for the foundry operation. There were no detected concentrations of petroleum hydrocarbons or purgeable aromatic compounds in a groundwater sample collected from monitoring well MW-2 in October 1986. Further discussion of the 1986 sampling efforts is presented in Section 2.4 of the Work Plan.

Groundwater monitoring for the STF project was initiated in April 1991. During the first attempt at measuring the water level in MW-2 at the site, a floating (i.e., free phase) layer of petroleum product was found in the well. In addition, the apparent vandalism of MW-4 at the site was discovered.

Upon finding the product and notification of the EPA, the Order on Consent between Amsted Industries (owner of this property) and the EPA was negotiated to encompass the investigation and delineation of the soil and groundwater relative to the presence of the free-phase product. In response to these findings, two attempts were made to bail product from MW-2, and a preliminary evaluation of the problem was made.

This preliminary work, including the attempts at bailing the well, observation of the product, and laboratory testing, was presented in the *Well Closure and Preliminary Fuel Investigation, Former Griffin Wheel Brass Foundry, Tacoma, Washington*, by Kennedy/Jenks Consultants dated July 1991. Results of this testing indicate the presence of a relatively high-viscosity petroleum product that would make future recovery operations difficult. In addition, MW-4 was closed in accordance with State of Washington regulatory requirements (WAC-173-160).

Since the subject site is part of the STF Superfund site currently under investigation, the results of work performed for the STF project that are applicable to the

subject site have been utilized as much as possible in the development of the Work Plan and will continue to be used to interpret the findings of ongoing investigations.

As described in the Work Plan, the investigation discussed in this report involved the installation of six planned resource protection wells in the vicinity of the former USTs. After these wells were installed, one additional well (NMW-14) was installed based on the apparent presence of oily soil in the boring for well NMW-9.

1.3 SCOPE OF ACTIVITIES

The investigative work conducted under the Work Plan was developed to characterize the presence and distribution of relatively immiscible petroleum product found in MW-2. This work addresses the investigation and remedial action activities described in the Order on Consent (hereinafter "the project"). This work provides substantive data required to complete the project, and is a significant step in characterizing the distribution of hydrocarbons in the subsurface.

The scope of work included in the Work Plan included the following generalized tasks:

- Well installation
- Water level monitoring
- Evaluation of product layer response to product recovery
- Soil, groundwater, and product sample collection
- Laboratory analyses (including validation)
- Investigative data evaluation

- Remedial alternatives evaluation
- Report preparation.

This report presents data collected during implementation of the Work Plan and the evaluation of the data with respect to the nature and the extent of hydrocarbons in the subsurface. It also discusses field procedures, field observations, and summarizes and evaluates various potentially applicable technologies for remediation of free-phase petroleum products in the subsurface. This report concludes with a recommended action based on identified site conditions and adjacent property uses.

The majority of this investigative effort focused on characterization of the extent of free-phase product in the subsurface. This report also presents data generated from laboratory testing of groundwater samples collected from wells that do not contain free product. These data are compared with drinking water standards and will be used to help select parameters for future monitoring and data collection.

2.0 INVESTIGATIVE METHODS

This section describes the field activities associated with the well installation and monitoring at the former Griffin Wheel Brass Foundry. Field procedures used during the field activities are described in the Standard Operating Guidelines (SOGs), which were provided as Appendix E to the Work Plan.

2.1 MONITORING WELL AND PRODUCT RECOVERY WELL INSTALLATION

Six monitoring wells (NMW-8, NMW-9, NMW-10, NMW-11, NMW-12, and NMW-14) and one product recovery well (NMW-13) were installed during this investigation. The numbering system used to designate these wells was based on a continuation of the numbering scheme used during the STF Remedial Investigation (RI). The siting rationale for wells NMW-8 through NMW-13 was described in Section 3.0 of the Work Plan. Monitoring well NMW-14 was installed to provide an additional exploration to characterize the lateral extent of petroleum hydrocarbons in soil and/or groundwater, based on the discovery of petroleum hydrocarbons in soil during the installation of monitoring well NMW-9. The locations of these wells with respect to existing structures and existing monitoring wells (MW-1, MW-2, and MW-3) are shown on the Partial Plan, entitled Subsurface Investigation (Appendix B).

The wells were installed using a hollow-stem auger drill rig. The monitoring well borings were drilled initially with 4.25-inch inner-diameter (I.D.) augers to allow for placement of 2-inch diameter well casing. One well boring (NMW-9) was over-drilled with 6.25-inch I.D. augers to allow for placement of 4-inch diameter well casing. NMW-9 was completed using 4-inch diameter casing and screen as a contingency measure to permit its use in future recovery efforts because oily soil was encountered in the well boring during drilling. The boring for product recovery

well NMW-13 was drilled with 8.25-inch I.D. augers to allow for placement of 6-inch diameter well casing.

Drilling and well installation were conducted in accordance with the requirements of Minimum Standards for Construction and Maintenance of Wells (WAC 173-160) for resource protection wells, and the procedures described in SOG-11 in the Work Plan. Borehole logging was completed using the procedures described in SOG-15. Copies of the boring and well construction logs are provided in Appendix C.

A sieve analysis was performed on a soil sample collected from the saturated zone in the boring for well NMW-8 to determine the grain-size distribution. This information was used to select the screen slot size and filter pack material in accordance with SOG-16 in the Work Plan. A plot of the sieve analysis is contained in Appendix C.

The NMW-8 saturated zone soil sample was retained and visually compared with samples collected from the saturated zone in the well borings for wells NMW-9, NMW-10, NMW-11, NMW-12, NMW-13, and NMW-14. Based on the field geologist's visual comparisons, the soil textures throughout the screened stratigraphic intervals in each of the other wells were determined to be similar to the texture of the NMW-8 sample, and the same filter pack and screen slot size was used for all of the monitoring wells. The filter pack selection was conservative (i.e., a smaller filter pack size was used than the maximum permissible size allowed according to SOG-16 for the monitoring wells, based on the premise that the purpose of the wells was to obtain groundwater samples with minimal turbidity). A larger filter pack size, still within the maximum limit allowed by SOG-16, was used for the product recovery well. The larger size was considered appropriate to promote the flow of viscous hydrocarbon product into the well for recovery purposes.

2.2 WELL ELEVATION SURVEYING

Elevations of the well casings and adjacent ground surfaces were surveyed using monitoring well MW-2 as an elevation reference point. This well was surveyed during the STF Groundwater Investigation. Horizontal control was obtained by taping distances from previously surveyed points on the ground surface. Locations of the monitoring and product recovery wells in relation to existing structures at the site are shown on the Partial Plan, Subsurface Investigation (Appendix B). Table 2-1 is a list of elevations that were measured during this investigation.

2.3 FLOATING HYDROCARBON PRODUCT SAMPLING

Prior to drilling and well installation, a sample of floating product was bailed from monitoring well MW-2 and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (BNAs), pesticides/polychlorinated biphenyls (PCBs), and metals using EPA's Contract Laboratory Program (CLP) methods. In addition, the product sample was analyzed for polynuclear aromatic hydrocarbons (PAHs) using EPA Method 8310. The results of the laboratory analyses are presented in Appendix D.

2.4 SOIL SAMPLING

Soil samples were typically collected from the well borings at 5-foot intervals. Additional soil samples were collected from the unsaturated zone just above the water table. Depths at which soil samples were collected are shown on the boring and well construction logs (Appendix C).

Soil samples were collected using a drive sampler fitted with 2.5-inch outside diameter (O.D) stainless steel liners. A total of three soil samples were selected for laboratory analysis using the selection criteria described in Section 3.0 of the Work

TABLE 2-1

SURVEY DATA FOR MONITORING AND PRODUCT RECOVERY WELLS

Well No.	Location No.	Ground Surface Elevation (ft MSL[a])	Casing Elevation (ft MSL[a])[b]
NMW-8	1789	250.7	252.66
NMW-9	1790	250.8	253.57
NMW-10	1791	250.9	253.18
NMW-11	1792	249.7	251.85
NMW-12	1793	250.2	252.27
NMW-13	1794	250.0	252.14
NMW-14	1795	247.1	249.22

Notes:

(a) Feet above mean sea level, City of Tacoma NGVD 29 vertical datum.
(b) Elevation of top of PVC casing, City of Tacoma NGVD 29 vertical datum.

Plan. Samples were analyzed for VOCs, semivolatiles, and metals using CLP methods. At EPA's request, samples were later analyzed for total petroleum hydrocarbons (TPH) by Method WTPH-418.1 (Washington State Method). An additional soil sample from the boring for NMW-14 was also selected for laboratory analysis due to the apparent presence of organic vapors. This sample was analyzed for volatile and semivolatile compounds also using CLP methods. Analytical results for soil samples are presented in Appendix E. The remaining samples were archived.

2.5 WELL DEVELOPMENT AND GROUNDWATER SAMPLING

Wells were developed using the procedures described in SOG-17 of the Work Plan. Following development and a waiting period, groundwater samples were collected from new monitoring wells NMW-8, NMW-9, NMW-10, NMW-11, NMW-12 and NMW-14 and from existing monitoring wells MW-1 and MW-3 on 4 and 5 May 1992. The new monitoring wells were purged and sampled using a 2-inch Teflon and stainless steel submersible pump. Existing monitoring wells were purged and sampled using the dedicated pumps that are installed in those wells. Groundwater purging and sampling were performed using the procedures described in SOG-12 of the Work Plan. Groundwater samples were analyzed for the same parameters that were specified for groundwater samples collected during the STF RI. In addition, groundwater samples were analyzed for TPH. Groundwater analytical results are contained in Appendix F.

EPA later requested a groundwater sample to be collected and analyzed from monitoring well NMW-13. Therefore, a groundwater sample was collected from well NMW-13 on 18 September 1992 and analyzed for volatiles and semivolatiles compounds by EPA CLP methods. The sample was also analyzed for PAHs by EPA Method 8310 and TPH by WTPH-418.1.

Before boring for NMW-14 began, the criteria for determining laboratory analysis was established in discussions with EPA. It was decided that a sample would be analyzed if a reading above 20 ppm was recorded on the Organic Vapor Analyzer (OVA). A reading of 36 ppm was recorded from the sample collected from 40 feet BGS in this boring. The water table was at a depth of approximately 28 feet BGS. This sample was collected below the fill material in the native soil, which had not been previously disturbed. Since the sample was collected 12 feet below the water table, had no petroleum odor, was not discolored or stained, and previous sampling of soil and groundwater at depths below the water table did not contain appreciable levels of metals and PCBs/pesticides, these analyses were not performed on the soil sample from NMW-14.

Analytical results associated with this sampling are also presented in Appendix F.

2.6 MONITORING WELL OBSERVATIONS

The product recovery well (NMW-13) was monitored over a 4-week period following its installation. The purpose of monitoring was to observe and measure, if possible, changes in the thickness of the floating hydrocarbon product with time. The new monitoring wells (NMW-8, NMW-10, NMW-11, NMW-12, and NMW-14) were not monitored because floating product was not present.

The product recovery well (NMW-13) was monitored on 10 separate days. Monitoring consisted of placing a bailer in the well at the groundwater surface and extracting water and product, if present. The well was also pumped on two separate days. Observations were then recorded. These observations are described in Section 4.1.

Monitoring of the new well NMW-9 occurred six separate times beginning in April 1992. As described in Section 4.1, "Field Observations and Evaluation," monitoring was discontinued because no floating product was observed when the well was

bailed. In addition, when groundwater was collected from all the wells for laboratory analysis on 4 and 5 May 1992, no floating product was observed in monitoring well NMW-9.

3.0 QUALITY ASSURANCE AND DATA VALIDATION

3.1 FIELD QA/QC PROCEDURES

During field operations, quality control (QC) samples were collected to monitor both field and laboratory operations. The purpose of this monitoring was to facilitate the evaluation of the precision and the accuracy of analytical data throughout the project. QC samples consisted of a field duplicate and blank samples (i.e., rinsates and trip blank samples) collected during groundwater sampling.

One field duplicate groundwater sample was collected from one well during the May sampling event. The field duplicate was assigned a unique sample number, and was submitted and analyzed as a separate sample. This sample was not identified to the analytical laboratory as a duplicate. The duplicate sample was collected in accordance with SOG-14 of the Work Plan.

One blank sample was submitted for laboratory analysis for each day spent in the field sampling groundwater. A rinsate sample and trip blank sample were submitted with the May sampling event. A rinsate sample was also collected during the September sampling event. The rinsate blank samples were collected when decontamination of sampling equipment was performed (e.g., when non-dedicated bailers and/or pumps were used for sampling). The rinsate samples were collected to monitor the effectiveness of decontamination procedures and to identify the potential for cross-contamination between sampling locations. The rinsate samples were collected by rinsing decontaminated sampling equipment with deionized water and placing the collected rinsate water in appropriate containers with required preservatives. The rinsate samples were analyzed for the same constituents as the groundwater samples.

One trip blank was submitted for the May sampling event. The trip blank was carried during sampling and submitted for analysis to monitor for possible volatile organic contamination caused by diffusion of organic contaminants through the septum of the sample vials during transport to and from the laboratory, as well as to monitor the quality of the laboratory water. The trip blank was prepared by the laboratory by filling a volatile organic analysis (VOA) vial with deionized water and shipping the blank with the sample containers. The trip blank was analyzed for VOCs only.

Analytical results for QC samples are presented in Appendix F. These results were evaluated by EcoChem, Inc. (EcoChem) as part of the data validation requirements (Section 3.3). Discussions of this evaluation are presented in the Groundwater Data Validation Reports (Appendix G).

3.2 LABORATORY QA/QC REVIEW

Analytical methods outlined in EPA's CLP Statements of Work (EPA 1988a; 1990a,b) were used to measure organic and inorganic constituents. EPA's CLP methods specify QC procedures that the laboratory is expected to meet or exceed. These procedures include analysis frequency and QC limits for laboratory method blanks, spiked samples, duplicates, and laboratory control samples. Analytical results and QC criteria were evaluated by the laboratory as part of their data reduction and documentation procedures, and in accordance with those procedures outlined in the STF Quality Assurance Project Plan (QAPjP) (Kennedy/Jenks/Chilton 1991a). Laboratory qualifiers were assigned to data during this review as outlined in the CLP Statements of Work (EPA 1988a; 1990a,b).

3.3 DATA VALIDATION

Data validation of analytical results was performed to evaluate procedural compliance with QA objectives as outlined in the STF QAPjP (Kennedy/Jenks/Chilton 1991a) and to assess the laboratory's performance in meeting the QC specifications for detection limits, accuracy, precision, and completeness as outlined in the CLP Statements of Work (EPA 1988a; 1990a,b). Data validation was performed by EcoChem.

Data validation was based on the criteria described in the functional guidelines for evaluating inorganic and organic analyses (EPA 1988b,c,d). Data that did not meet required criteria were flagged with validation qualifiers. A 100-percent data validation was completed for all groundwater and product analytical results. In addition, three of four soil analytical results were also validated. The data validation reports are presented in Appendix G.

4.0 INVESTIGATIVE FINDINGS

4.1 FIELD OBSERVATIONS AND EVALUATION

Observations were made during installation of soil borings, well development, and through periodic pumping and bailing. The observations provide a partial understanding or conceptual view of the subsurface conditions in the area of the borings. The information gathered was considered when remediation alternatives described in Section 5.0 were evaluated and was used to arrive at the conclusions presented in Section 6.0.

Boring and well construction logs for the new wells are included in Appendix C. Information from these new well logs and the well log from MW-2 was used to construct the geologic cross-sections included in Appendix B. Information from other borings installed as part of the STF project were also used to construct the geological sections. (The lithology below the bottom of the new wells was interpreted from information obtained from deeper borings.)

Borings NMW-9, NMW-13, and MW-2 contain petroleum-contaminated soil. Soil particles from the sample collected from 15.0 to 17.0 feet below ground surface (BGS) in NMW-13 were coated with a visible petroleum sheen. Heavy staining was found in the NMW-13 soil samples collected from 20.0 to 22.0 feet BGS and 25.0 to 27.0 feet BGS. Samples collected from the boring for NMW-9 were stained below 23.0 feet BGS. The well log for monitoring well MW-2 indicates "moderate hydrocarbon odor and visible contamination" from the sample collected at 23.5 feet BGS. Visible petroleum contamination was not observed below the zone of water table fluctuation in any boring, and was not observed in any boring above the zone of water table fluctuation except NMW-13.

Some petroleum-contaminated soil was removed at the time the USTs were removed, indicating a release occurred at or near the tanks. However, the exact point of the release or type of release (i.e., surface spill, tank overflow, pipeline leak, or tank leak) was not identified. Petroleum-contaminated soils were found nearest to the ground surface at NMW-13, suggesting that the release probably occurred close to well NMW-13.

The horizontal limits of the petroleum-contaminated soil for the zone surrounding the point of release were generally defined. Cross Sections A-A and B-B (Appendix B) show estimated horizontal and vertical extent of product in the soil. The Partial Plan, Subsurface Investigation (Appendix B) shows the estimated horizontal extent of product in the soil. These drawings were constructed by considering both the position of the product and its vertical thickness to project the position of the boundary of the contaminated zone. The monitoring wells surrounding the former tank location (i.e., NMW-8, NMW-10, NMW-11, NMW-12, NMW-14, and MW-2) do not currently contain observable evidence of product in soil or groundwater.

Well NMW-13 was regularly pumped and/or bailed throughout the month of April 1992 (i.e., 2, 3, 4, 6, 8, 11, 14, 18, 22, and 30 April 1992). Well NMW-9 was also bailed periodically. However, no floating product was observed, and observations were discontinued. Well NMW-9 was monitored and a groundwater sample collected on 4 May 1992. Again, no floating product was observed in the well. A pneumatic ejector pump, operating at approximately 0.5 gallons per minute (gpm), was used for pumping well NMW-13. The pump was raised and lowered within the water column inside the well. The pump was positioned at both the bottom of the well and at just below the surface of the fluid column in the well. This provided the ability to pump both water and product from the well. The other monitoring wells also were bailed to monitor for the possible presence of product.

The flow of free-floating product into NMW-13 occurs at an extremely slow rate. No product was ever recovered inside the bailer when the well was bailed, although

the surface of the water table inside the well contained some globules of free-floating product. This material was removed by pumping. It was skimmed from the liquid surface by positioning the pump intake at the liquid surface. No product was recovered by pumping from any other level inside the well. The amount of product collected was estimated to be less than 100 ml and was observed floating on the liquid surface inside the drums used to collect the pump discharge water.

The globules of floating product were not present in sufficient quantity to cover the water surface in well NMW-13 and were deflected away from the bailer when attempts were made to remove them by bailing. On the final bailing attempt, paper towels were affixed to the bailer and used as a sorbent medium. This increased the amount of product collected by bailing. This exercise demonstrates that the amount of product potentially recoverable by pumping or bailing techniques is negligible.

Product thickness observed in MW-2 during the two bailing and sampling events was estimated to be a maximum of several inches in thickness. The initial report by field personnel who discovered the product in MW-2 stated that the product thickness might be several feet. Current findings support the observation that water table fluctuations over the 6-year period since well MW-2 was installed probably coated the inside surface of the well screen with the floating product; however, the actual floating product thickness in the well is only a maximum of several inches.

Product thickness measurements from a monitoring well are often considerably thicker than the actual thickness of the floating product in the formation surrounding the well. This phenomena is caused by a capillary rise of floating product above the water table. The product then flows into the well, and the force of the product above the water displaces the water with product. Equipment manufacturers often claim that their product skimming systems can recover free product floating on the water table down to one-quarter inch or less. Our experience with a variety of product skimming systems is that effective operation of these systems in this range

only occurs under ideal conditions. Several conditions for ideal operation, which are not met at this property, are as follows:

- Pumping from shallow depths so that product thickness and the water table surface can be easily observed and the system finely adjusted

- Fluctuation in the water table elevation is very small so that the vertical position of the equipment, once the system is adjusted, does not have to be frequently changed.

4.2 CHEMICAL ANALYSIS OF SOIL SAMPLES

Soil samples were collected from the borings at depths where hydrocarbons were visually evident in order to assess whether potentially hazardous substances were contained in the hydrocarbon material.

Previous sampling of the petroleum product within MW-2 showed a variety of compounds typical of heavy hydrocarbon product including semivolatile compounds (primarily PAHs), as well as low concentrations of metals and volatile organics. PAH compounds were typically the non-carcinogenic, low molecular weight variety, except for chrysene, which is a suspected carcinogen. Benzene was the only detected volatile compound that is a suspected carcinogen. Metals concentrations in the product appear to be below background soil concentrations for the site (Kennedy/Jenks Consultants 1991). For reference, analytical results for the petroleum product are presented in Table 4-1.

A total of 64 new soil samples were collected from seven new borings. Four of these samples were submitted for laboratory analysis. The results are presented in Table 4-2. The original criteria as set forth in the Work Plan was to analyze one sample from each of four depth ranges. The sample which appeared to have a high concentration of product in each depth range was selected. Only one sample with

TABLE 4-1

SUMMARY OF ANALYTICAL RESULTS FOR PETROLEUM PRODUCT[a,b]
FORMER GRIFFIN WHEEL BRASS FOUNDRY

Analyte	Sample Results (µg/kg)			Duplicate Results (µg/kg)		
VOLATILES						
Methylene Chloride	B	2,000	R[c]	B	790	UJ[d]
Acetone	J[e]B	300	R	JB	340	UJ
Benzene	U[f]	50	R		60	
Ethyl Benzene		810	R		1,800	
Xylenes		420	R		920	
PESTICIDES/PCBs		ND[g]			ND	

Analyte	Sample Results (mg/kg)	Duplicate Results (mg/kg)
METALS[h]		
Copper	6.5	6.0
Nickel	17.8	16.5
Vanadium	19.2	22.3

	BNA and PAH (CLP Methods)		PAH (Method 8310)	
Analyte	Sample Results (µg/kg)	Duplicate Results (µg/kg)	Sample Results (µg/kg)	Duplicate Results (µg/kg)
SEMIVOLATILES				
2-Methylnaphthalene	290,000 J4[i]	380,000		
Carbazole	32,000 J4	U 20,000		
Naphthalene	83,000 J4	110,000	U 240,000	U 240,000
Acenaphthene	44,000 J4	U 20,000	U 240,000	U 240,000
Fluorene	110,000 J4	140,000	66,000	69,000
Phenanthrene	200,000 J4	200,000	120,000	120,000
Fluoranthene	32,000 J4	39,000	240,000	330,000
Pyrene	78,000 J4	82,000	35,000	35,000
Chrysene	77,000 J4	62,000	U 24,000	U 24,000

(a) Only analytical results for compounds that were detected are provided in this table.
(b) Results are reported on a wet-weight basis.
(c) B is a laboratory qualifier that is used when the analyte is found in the associated blank as well as in the sample. R is a data validation qualifier that indicates the data are unusable. The analyte was analyzed for, but the presence or absence of the analyte has not been verified.
(d) UJ is a data validation qualifier that indicates the analyte was analyzed for and was present above the level of associated value.
(e) J is a laboratory qualifier that indicates an estimated value.
(f) U is a laboratory qualifier that indicates the compound was analyzed for, but not detected.
(g) ND = Not detected.
(h) Only compounds detected above the contract required detection limit (CRDL) are presented.
(i) J4 is a data validation qualifier that indicates the analyte was analyzed and was positively identified, but the associated value may not be consistent with the amount actually present in the sample.

TABLE 4-2

SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES[a,b]
FORMER GRIFFIN WHEEL BRASS FOUNDRY

Analyte	Boring No. NMW-9 (Sample Depth 23 ft.)	NMW-10 (Sample Depth 27 ft.)	NMW-13 (Sample Depth 29.5 ft.)	NMW-14[c] (Sample Depth 39 ft.)	Site Background Max.[d]
VOLATILES (µg/Kg)					
Methylene Chloride	ND[e]	ND	ND	JB[f] 9.0	--
Acetone	ND	ND	ND	B 26.0	ND
Toluene	J 6.0	ND	ND	ND	ND
Ethyl Benzene	74	ND	ND	ND	ND
Xylenes	173	ND	ND	ND	ND

Analyte	NMW-9	NMW-10	NMW-13	NMW-14	Site Background Max.[d]
SEMIVOLATILES (µg/Kg)					
Naphthalene	9,300	ND	J 1,600	ND	ND
2-Methylnaphthalene	22,000	ND	3,800	ND	ND
Acenaphthene	J 2,400	ND	ND	ND	ND
Dibenzofuran	J 790	ND	J 160	ND	ND
Fluorene	3,800	ND	J 840	ND	ND
Phenanthrene	5,100	ND	J 1,300	ND	91
Anthracene	J 930	ND	J 140	ND	14
Di-n-butylphthalate	ND	ND	ND	B 1,000	110
Fluoranthene	J 310	ND	J 160	ND	200
Pyrene	J 1,300	ND	J 370	ND	220
Butylbenzylphthalate	ND	ND	ND	J 48	ND
Chrysene	J 1,100	ND	J 330	ND	130
Bis(2-Ethylhexyl)phthalate	JB 1,400	ND	ND	J 60	280
Benzo(k)fluoranthene	ND	ND	J 160	ND	49

TABLE 4-2

SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES[a,b]
FORMER GRIFFIN WHEEL BRASS FOUNDRY

Analyte	NMW-9	NMW-10	NMW-13	Site Background Max.[d]
TOTAL PETROLEUM HYDROCARBONS (mg/Kg)	5,300	ND	1,800	NA
METALS (mg/Kg)[g]				
Aluminum	9,640	10,400	9,740	21,900
Arsenic	2.5 J4	<CRDL	<CRDL	12
Barium	<CRDL	<CRDL	57.7	161
Calcium	4,320	4,460	3,770	4,400
Chromium (total)	21.3	23.5	20.8	30
Copper	13.3	12.3	20.9	34
Iron	14,900	15,700	15,000	16,700
Lead	1.2 J4	1.1 J4	3.0 J4	155
Magnesium	5,020	5,430	5,320	4,690
Manganese	261	282	237	634
Nickel	30.6	31.2	30.3	37
Vanadium	34.4	36.7	30.6	35
Zinc	30.8	31.6	33.2	135

Notes:

(a) Only analytical results for compounds that were detected are provided in this table.
(b) Results are reported on a dry-weight basis.
(c) Sample not validated.
(d) Maximum detected background concentration from STF Soil Investigation (Kennedy/Jenks Consultants 1991).
(e) ND = Not detected.
(f) B is a laboratory qualifier that is used when the analyte is found in the associated blank as well as in the sample.
J is a laboratory qualifier that indicates an estimated value.
(g) Only compounds detected above the CRDL are presented.

minimal evidence of petroleum product contamination was found in the 0 to 11.5 depth range and therefore the sample was not analyzed. This sample was from the boring for well NMW-13.

The volume of the sample retained in the split spoon in several cases was also not sufficiently large to provide a "split" for division with ICF (EPA's oversight contractor) and therefore these samples were excluded from selection for analysis. The samples chosen for analysis were those appearing to be most contaminated, while having sufficient volume for splitting of the sample with EPA's oversight contractor.

Comparison of the results from the soil samples with the results from an analysis of the product collected show approximately the same constituents but lower concentrations in the soil samples. The samples analyzed appear adequate to characterize the chemical constituents of the contaminated soil. The visual observations of the 64 soil samples and OVA readings were useful in characterizing the extent of product in the subsurface soils. Laboratory analysis was conducted to determine some of the important physical and chemical parameters of the product. This testing is sufficient to identify and characterize the product as heavy fuel oil (HFO). Varying concentrations of the released product are expected to be found in the soil. The highest concentrations are anticipated to be near the release point. Drilling cuttings from NMW-13 were stained black in color (see the boring and well construction log, Appendix C). Product accumulation on the water table may indicate that soil strata above the water table at some locations are nearly saturated. Sampling and analysis of soil samples were performed to assess concentrations of contaminants at various depths. The samples submitted for analysis represent the more visually contaminated samples, although we observed that there may be soils with slightly higher concentrations of HFO.

Originally, four soil samples were to be analyzed for the constituents found in the hydrocarbon sample (i.e., semivolatiles, VOCs, and metals). Soil samples were selected from borings NMW-9, NMW-10, and NMW-13 at depths ranging from 23

to 29.5 feet BGS for laboratory analysis. An additional soil sample was collected during the installation of NMW-14 (39 feet) due to the presence of odors. This sample was analyzed for volatile and semivolatile compounds only (see discussion below).

The analytical results for the soil samples and appropriate site background concentrations are summarized in Table 4-2. Complete analytical results are provided in Appendix E.

A discussion of the sampling results is provided below for each class of chemical.

4.2.1 Volatiles

One soil sample (at NMW-9) contained constituents typical of hydrocarbon products, including toluene, ethyl benzene, and xylene. Concentrations of these contaminants were less than one hundred times the groundwater cleanup standard under MTCA. Benzene, which was detected in the product sample, was not detected in the soil samples, probably due to volatilization from the soil. Methylene chloride and acetone were detected in one sample (NMW-14); however, these compounds were also detected in the laboratory blank.

4.2.2 Semivolatiles

A variety of semivolatile compounds, primarily PAHs, were detected in two of the soil samples (NMW-9 and NMW-13). These compounds are typical of those found in heavy petroleum products and similar to those detected in the product sample. In general, PAH concentrations were greater in samples with higher concentrations of total petroleum hydrocarbons since these PAHs tend to remain associated with other hydrocarbon compounds. Two of the PAHs detected in soil are suspected

carcinogens [benzo(k)fluoranthene and chrysene], however, these compounds are present in very low concentrations compared with non-carcinogenic PAHs.

Several phthalate compounds were detected in one soil sample (NMW-14). Phthalates are known to be associated with petroleum products and several are suspected carcinogens. The PAHs and phthalates detected in soil samples are likely constituents of the source HFO. These compounds were likely not detected in the source HFO due to elevated detection limits.

4.2.3 Metals

Metals concentrations detected in the three soils samples were consistent with or below area background (as established by the STF RI) in all cases.

4.2.4 Total Petroleum Hydrocarbons

TPH concentrations in soil samples for NMW-9 and NMW-13 were 5,300 and 1,800 mg/kg, respectively. TPH was not detected in the soil sample from NMW-10. Little information is available regarding TPH as a class of compounds and corresponding health effects. In general, individual TPH constituents need to be evaluated regarding potential health risks.

4.2.5 Discussion

Concentrations of chemicals in soil samples appear representative of background concentrations detected at the STF site except for PAHs, TPH, and several phthalate compounds. The PAHs and phthalates appear to be a constituent of the hydrocarbon product with concentrations of PAHs and phthalates increasing with increasing TPH concentrations. It appears that the potential for exposure (via

ingestion) to these compounds is minimal. Therefore, comparison with established MTCA cleanup levels (based on soil ingestion) or EPA screening levels does not appear appropriate. The potential threats associated with these compounds appear to be due to their potential to leach into groundwater and thus impact nearby drinking water wells.

4.3 GROUNDWATER SAMPLING AND ANALYSIS PROGRAM

In order to assess the potential for migration in groundwater of petroleum hydrocarbon constituents away from the identified floating product zone and contaminated vadose zone, groundwater samples were collected and analyzed from monitoring wells that did not contain visible hydrocarbon contamination. Initially, all wells installed during the investigation were sampled with the exception of NMW-13, which exhibited visible HFO contamination. Groundwater samples from existing monitoring wells (MW-1 and MW-3), along with new monitoring wells installed during the subject investigation (NMW-8 through NMW-12 and NMW-14), were collected and analyzed for organic and inorganic compounds that were specified for analyses as part of the STF RI. Groundwater samples were also analyzed for TPH, total organic carbon (TOC), total dissolved solids (TDS), and total suspended solids (TSS). Field QC samples collected during the May sampling event included a field duplicate sample from monitoring well NMW-8, a rinsate sample, and a trip blank sample.

Groundwater samples were collected from the wells following the protocol established SOG-12 of the Work Plan, Well Installation and Monitoring, Former Griffin Wheel Brass Foundry, Tacoma, Washington, Kennedy/Jenks Consultants, February 1992. Prior to sampling, all wells were purged until pH, temperature, and conductivity stabilized.

Following initial review of soil and groundwater sampling results by EPA, monitoring well NMW-13 was sampled on 18 September 1992 to assess whether hazardous

substances had leached from the petroleum product known to be present on the groundwater surface in this well.

The groundwater sample from NMW-13 was analyzed only for those constituents detected in the monitoring wells that had been previously sampled, including volatiles, semivolatiles, PAHs, and TPH. A rinsate sample was also collected during this sampling event and analyzed for the same parameters as the groundwater sample. The analytical methods for the groundwater sample from NMW-13 and the rinsate sample were consistent with the analytical methods used for the other water samples.

A summary of groundwater analytical results is provided in Table 4-3 along with appropriate regulatory criteria applicable to each analyte. Complete analytical results are provided in Appendix F. A discussion of the monitoring results is provided below for each class of chemical.

4.3.1 Volatiles

Chloroform was detected in four of the eight groundwater samples, all at an estimated concentration of 2 μg/L. The presence of chloroform may be the result of a former leaking water line that was recently repaired, located just north of the groundwater monitoring well network. Chloroform concentrations were well below the maximum contaminant level (MCL) under the Safe Drinking Water Act.

Several tentatively identified volatile compounds that appear to be constituents of fuel oil were detected at low concentrations [< 10 parts per billion (ppb)] in well NMW-9.

Subsequent sampling of NMW-13 showed an estimated low concentration (9.0 μg/L) of 2-butanone.

TABLE 4-3

SUMMARY OF GROUNDWATER ANALY

Analyte (µg/L)	Well Number (Location Number)						
	MW-1 (1773)	MW-3 (1775)	NMW-8 (1789)	Dup 8 (2000)	NMW-9 (1790)	NMW-10 (1791)	NMW (17
VOLATILES							
Chloroform	ND[c]	ND	J[d] 2.0	J 2.0	ND	J 2.0	J 2.
2-Butanone	ND	ND	ND	ND	ND	ND	NI
PESTICIDES/PCBs							
beta-BHC	ND	ND	ND	ND	0.13	ND	NI
Endosulfan 1	ND	ND	ND	ND	0.34	ND	NI
Dieldrin	ND	ND	ND	ND	0.10	ND	NI
SEMIVOLATILES[k]							
Naphthalene	ND	ND	ND	ND	ND	ND	NI
2-Methyl-naphthalene	ND	ND	ND	ND	ND	ND	NI
Acenaphthene	ND	ND	ND	ND	ND	ND	NI
Dibenzofuran	ND	ND	ND	ND	ND	ND	NI
Fluorene	ND	ND	ND	ND	ND	ND	NI
Phenanthrene	ND	ND	ND	ND	ND	ND	NI
Carbazole	ND	ND	ND	ND	ND	ND	NI
bis(2-ethylhexyl)phthalate	J 0.6	ND	ND	ND	J 3.0	J 0.8	J 0.
PAHs[q]							
Phenanthrene	ND	ND	ND	ND	ND	ND	NI
Anthracene	ND	ND	ND	ND	ND	ND	NI
Fluoranthene	ND	ND	ND	ND	ND	ND	NI
Pyrene	ND	ND	ND	ND	ND	ND	NI
METALS[k]							
Aluminum	ND	<CRDL	891	877	<CRDL	1,091	1,1
Calcium	14,800	9,290	12,600	13,000	35,200	18,600	30,
Chromium	ND	ND	<CRDL	<CRDL	<CRDL	<CRDL	10
Copper	ND	ND	3.4 J4	2.5 J4	1.7 J4	2.3 J4	2.
Iron	477 J4	2,470 J4	1,370 J4	1,380 J4	196 J4	1,080 J4	1,4
Lead	ND	<CRDL	3.9 J4	3.0 J4	<CRDL	<CRDL	3.

TABLE 4-3

Y OF GROUNDWATER ANALYTICAL RESULTS[a]

Well Number (Location Number)							Regulatory Criteria		
Dup 8 (2000)	NMW-9 (1790)	NMW-10 (1791)	NMW-11 (1792)	NMW-12 (1793)	NMW-13[b] (1794)	NMW-14 (1795)	MCL	MCLG	SMCL
J 2.0	ND	J 2.0	J 2.0	J 2.0	ND	ND	100	NA[e]	NA
ND	ND	ND	ND	ND	J 9.0 J[f]	ND	NA	NA	NA
ND	0.13	ND	ND	ND	--[g]	ND	[h]	NA	NA
ND	0.34	ND	ND	ND	--	ND	[i]	NA	NA
ND	0.10	ND	ND	ND	--	ND	[j]	NA	NA
ND	ND	ND	ND	ND	J 3.0	ND	[l]	NA	NA
ND	ND	ND	ND	ND	J 5.0	ND	NA	NA	NA
ND	ND	ND	ND	ND	J 1.0	ND	[m]	NA	NA
ND	ND	ND	ND	ND	J 0.5	ND	[n]	NA	NA
ND	ND	ND	ND	ND	J 2.0	ND	[o]	NA	NA
ND	ND	ND	ND	ND	J 2.0	ND	NA	NA	NA
ND	ND	ND	ND	ND	J 0.6	ND	NA	NA	NA
ND	J 3.0	J 0.8	J 0.6	J 0.7	ND	J 0.7	4[p]	0[p]	NA
ND	ND	ND	ND	ND	2.9	ND	NA	NA	NA
ND	ND	ND	ND	ND	0.064	ND	[r]	NA	NA
ND	ND	ND	ND	ND	4.3	ND	[s]	NA	NA
ND	ND	ND	ND	ND	4.0	ND	[t]	NA	NA
877	<CRDL	1,091	1,180	832	--	833	NA	NA	NA[v]
13,000	35,200	18,600	30,300	22,900	--	18,600	NA	NA	NA
<CRDL	<CRDL	<CRDL	10.1	10.1	--	ND	100	100	NA
2.5 J4	1.7 J4	2.3 J4	2.1 J4	2.8 J4	--	28.3	1,300[w]	1,300	1,000
1,380 J4	196 J4	1,080 J4	1,460 J4	1,140 J4	--	1,180 J4	NA	NA	300
3.0 J4	<CRDL	<CRDL	3.9 J4	<CRDL	--	13.9 J4	15[w]	0	NA

TABLE 4-3

SUMMARY OF GROUNDWATER ANALYTIC

Analyte (µg/L)	Well Number (Location Number)						
	MW-1 (1773)	MW-3 (1775)	NMW-8 (1789)	Dup 8 (2000)	NMW-9 (1790)	NMW-10 (1791)	NMW-11 (1792)
Manganese	154	543	74.6	76.1	907	38.6	61.0
Magnesium	<CRDL	<CRDL	11,400	11,400	27,100	7,530	11,200
Nickel	<CRDL	ND	<CRDL	<CRDL	43.2	<CRDL	<CRDL
Sodium	6,150	9,860	5,760	5,610	13,800	13,300	29,600
Zinc	42.6 J4	<CRDL	63.5 J4	<CRDL	<CRDL	<CRDL	<CRDL
Cyanide	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons	ND	ND	ND	ND	ND	ND	ND
Total Organic Carbon	3.4	2.0	1.6	1.47	11.2	1.6	31.6

Notes:

(a) Only analytical results for compounds detected in the groundwater samples are provided in this table.
(b) Well NMW-13 was sampled 18 September 1992 and was analyzed for volatile organic compounds (VOCs), semivolatile organic compounds, polyr
(c) ND = Not detected.
(d) J is a laboratory qualifier that indicates an estimated value.
(e) NA = Not available.
(f) J is a data validation qualifier that indicates the analyte was analyzed and was positively identified, but the associated value may not be consister
(g) "--" indicates not analyzed.
(h) EPA lowest risk based concentration is 0.05 µg/L at 10^{-6} risk.
(i) EPA lowest risk based concentration is 2 µg/L at Hazard Index of 1.0.
(j) EPA lowest risk based concentration is 0.005 µg/L at 10^{-6} risk.
(k) Semivolatile analysis was performed by EPA CLP.
(l) EPA lowest risk based concentration is 100 µg/L at Hazard Index of 1.0.
(m) EPA lowest risk based concentration is 2,000 µg/L at Hazard Index of 1.0.
(n) EPA lowest risk based concentration is 40 µg/L at Hazard Index of 1.0.
(o) EPA lowest risk based concentration is 1,000 µg/L at Hazard Index of 1.0.
(p) Proposed.
(q) PAH analysis was performed by EPA Method 8310.
(r) EPA lowest risk based concentration is 10,000 µg/L at Hazard Index of 1.0.
(s) EPA lowest risk based concentration is 1,000 µg/L at Hazard Index of 1.0.
(t) EPA lowest risk based concentration is 1,000 µg/L at Hazard Index of 1.0.
(u) Only compounds detected above the contract required detection limit (CRDL) are presented.
(v) Proposed SMCL is 50 µg/L.
(w) Action level.
(x) MTCA Method A Cleanup Level is 1 mg/l.

TABLE 4-3

OF GROUNDWATER ANALYTICAL RESULTS[a]

Well Number (Location Number)							Regulatory Criteria		
Dup 8 (2000)	NMW-9 (1790)	NMW-10 (1791)	NMW-11 (1792)	NMW-12 (1793)	NMW-13[b] (1794)	NMW-14 (1795)	MCL	MCLG	SMCL
76.1	907	38.6	61.0	31.3	--	121.0	NA	NA	50
11,400	27,100	7,530	11,200	9,990	--	11,700	NA	NA	NA
<CRDL	43.2	<CRDL	<CRDL	<CRDL	--	ND	100	100	NA
5,610	13,800	13,300	29,600	10,100	--	27,500	NA	NA	NA
<CRDL	<CRDL	<CRDL	<CRDL	<CRDL	--	28.7 J4	NA	NA	5,000
ND	ND	ND	ND	ND	--	ND	200[b]	200[b]	NA
ND	ND	ND	ND	ND	ND	ND	[x]	NA	NA
1.47	11.2	1.6	31.6	ND	--	ND	NA	NA	NA

ovided in this table.
anic compounds (VOCs), semivolatile organic compounds, polynuclear aromatic hydrocarbons (PAHs), and total petroleum hydrocarbons (TPH).

itively identified, but the associated value may not be consistent with the amount actually present in the environmental sample.

resented.

4.3.2 Pesticides/PCBs

Three pesticides (i.e., beta-BHC, endosulfan, and dieldrin) were detected in one of the eight groundwater samples (NMW-9). No MCLs exist for these compounds. Comparison of detected concentrations with EPA risk-based screening concentrations (EPA 1991) show that concentrations for carcinogens (i.e., beta-BHC and dieldrin) are above 10^{-6} risk levels, but below 10^{-4} risk levels. Detected concentrations are below EPA's risk-based screening levels for non-carcinogenic effects at a hazard index of 1. PCBs were not detected in any other groundwater monitoring wells sampled.

Pesticides and PCBs are not typically found in HFO and were not detected in the sample of HFO collected from monitoring well MW-2. The source of pesticides found in the sample collected from monitoring well NMW-9 is unknown, but its presence in groundwater is probably unrelated to the presence of HFO in the subsurface.

Pesticides and PCBs analysis was not performed on the groundwater sample subsequently collected from monitoring well NMW-13.

4.3.3 Semivolatiles

Bis(2-ethylhexyl)phthalate was the only semivolatile compound (including PAHs) detected in the groundwater samples collected during the May sampling event. This compound was detected in six of eight groundwater samples at estimated concentrations all below the proposed MCL.

Numerous tentatively identified compounds were detected at relatively low concentrations (less than 100 μg/L total) in all of the groundwater samples from the monitoring wells onsite. In general, these compounds can be characterized as typical of those contained in the heavy fuel oil mixtures known to be previously

used on the property. These hydrocarbons were also detected in the rinsate samples collected during the investigation.

Subsequent analyses of groundwater from NMW-13 detected low (estimated) concentrations of several non-carcinogenic PAH compounds. Concentrations of all detected compounds were less than 10 µg/l and are similar to compounds detected in soil and the hydrocarbon product. The compounds detected consisted of the lower molecular weight hydrocarbons which tend to be more mobile than the higher molecular weight (carcinogenic) PAH compounds. None of these compounds exceeded EPA's risk-based screening levels for non-carcinogenic effects at a Hazard Index of 1. There was good agreement between the detected concentration of phenanthrene using GC/MC (CLP) and HPLC (Method 8310) analysis. Several different non-carcinogenic PAHs were detected using the different analytical methods (i.e., HPLC versus CLP). It is likely that different compounds were reported since the reported concentrations were just above the detection limits. All the compounds that were detected using both methods are characteristic of HFO.

4.3.4 Metals

A variety of metals were detected in the majority of groundwater samples collected onsite. Aluminum, calcium, chromium, copper, iron, lead, manganese, magnesium, nickel, sodium, and zinc were all detected in at least one sample above the contract required detection limit (CRDL). The concentrations detected in the groundwater samples fell within the range detected during investigations being performed as part of the STF RI. None of the detected concentrations exceeded available MCLs. Iron and manganese exceeded secondary maximum contaminant levels (SMCLs) in most of the groundwater monitoring wells. This is similar to what has been observed for other monitoring wells throughout the STF site. No specific trends regarding the distribution of metal are apparent. Groundwater from NMW-13 was not analyzed for metals.

4.3.5 Cyanide

Cyanide was not detected in any of the monitoring wells onsite.

4.3.6 Total Petroleum Hydrocarbons

TPH were not detected (at a detection limit of 1 mg/l) in any of the groundwater samples collected from the site (including subsequent analyses of groundwater from NMW-13).

4.3.7 Total Organic Carbon

TOC concentrations were generally low and were typical of TOC measurements in other areas of the STF site.

4.4 DISCUSSION

The foregoing results indicate that petroleum hydrocarbons detected in subsurface soil at the Amsted site are not significantly impacting local groundwater. All contaminants detected from groundwater monitoring well samples that appear to originate from the migration of petroleum constituents are present at levels below the MCL. Contaminants that were detected above SMCLs were detected at concentrations typical of groundwater throughout the STF site. Pesticides were detected at one well at concentrations between EPA Region 10 risk-based concentrations at 10^{-4} and 10^{-6} risk levels. This was the only groundwater sample collected throughout the entire STF site that has contained detectable pesticide concentrations. PAHs were detected in groundwater from the well most impacted by HFO (NMW-13); however, all concentrations were below EPA's risk-based screening levels for non-carcinogens at a Hazard Index of 1.

4.5 HYDROGEOLOGY

A total of 19 sets of groundwater data are available from wells on and adjacent to the Amsted property. This data has been used to produce the contour maps included in Appendix H. Groundwater gradients, velocity, and approximate flow bearing have been calculated and measured from these contour maps. This data is included on Table 4-4. A sample calculation of average linear groundwater velocity is included below.

$$v = \frac{k}{n}\frac{dh}{dl} = \frac{160}{0.365} * 0.0034 = 1.49 \ feet/day^{(i)}$$

where:

k = hydraulic conductivity = 160 feet/day[ii]

n = average porosity = 36.5 percent[ii]

$\frac{dh}{dl}$ = slope of hydraulic grade line = 0.0034

v = average linear groundwater velocity

Notes:

(i) Calculation of maximum average groundwater velocity.

(ii) Remedial Investigation Report, Appendix GW - Groundwater Investigation Report. Kennedy/Jenks Consultants. 1992.

Figure 4 (Appendix H) shows the theoretical dissolved plume contaminant projection. Two of the potential plumes are shown projected in line with the two extreme flow directions measure from the contour maps. In reality, a plume originating from a source covering the area of contaminated soil shown in contact with the water table on Figure 4 would likely have a greater lateral spread than shown on this figure. From Figure 4 it is apparent that a contaminant plume in the direction of any of the flow bearings would likely intersect one or more of the surrounding

TABLE 4-4

GROUNDWATER PARAMETERS

Monitoring Month	Approximate Flow Bearing	Gradient[a] $\left(\frac{dh}{dl}\right)$	Average Linear Groundwater Velocity (V) (feet/day)
October 1982	N 50° W	0.0022	0.96
November 1982	S 80° W	0.0016	0.70
August 1989	N 78° W	0.0005	0.22
September 1989	N 53° W	0.0007	0.31
January 1990	S 61° W	0.0030	1.32
April 1991	N 69° E	0.0034	1.49
May 1991	S 53° W	0.0022	0.96
June 1991	S 52° W	0.0022	0.96
July 1991	S 46° W	0.0014	0.61
8 August 1991	S 53° W	0.0008	0.35
23 August 1991	N 10° E or S 73° W	0.0010	0.44
September 1991	N 41° E or S 66° W	0.0006	0.26
October 1991	N 30° W	0.0022	0.96
November 1991	N 48° W	0.0016	0.70
December 1991	N 44° E or S 54° W	0.0011 or 0.0023	0.48 or 1.01
January 1992	S 50° W	0.0011	0.48
February 1992	S 47° W	0.0028	1.23
13 March 1992	S 44° W	0.0020	0.88
30 March 1992	S 48° W	0.0014	0.61

Note:

(a) Gradients measured from contour maps. Kennedy/Jenks Consultants' Work Plan. Well Installation and Monitoring, Former Griffin Wheel Brass Foundry, Tacoma, Washington prepared for Amsted Industries dated February 1992 and recent data.

wells. Variation in flow direction will also spread the contaminant plume. However, recent sampling has not detected a dissolved contaminant plume.

Section 4.1.4.1 Regional Groundwater System, and Section 4.1.4.2 Local Groundwater System from Kennedy/Jenks Consultants' 1992 Groundwater Investigation Report, conducted as part of the South Tacoma Field Remedial Investigation are included in Appendix I. These sections of the report and accompanying figures present background on the regional and local groundwater system. Of particular importance are seasonal fluctuation of the water table, impact of the City of Tacoma production wells, and a description of geologic units at the site.

4.6 NATURE AND EXTENT OF PETROLEUM HYDROCARBONS IN THE SUBSURFACE

Petroleum product found in the subsurface at MW-2 appears to be the result of a release associated with the USTs near this location. One of the considerations prior to this phase of work started was that the product in the subsurface may have been the result of activities on the adjacent industrial property. Since product-free wells surround the former UST location at the former Griffin Wheel Brass Foundry, and soils above the water table in the vicinity of the former USTs contain product, it is unlikely that there is any other source possible than operations at the former Griffin Wheel Brass Foundry.

This product is similar to commercially available HFO. The standards for composition of HFO have been revised in the past, and the current standard for HFO is listed in the above-mentioned report. Grades 5 and 6 HFO are frequently referred to as Bunker B and Bunker C. The HFO used at the former Griffin Wheel Brass Foundry was called Bunker C. However, the viscosity of the product collected from MW-2 falls between the viscosity Grades 5 and 6 HFO. The product can generally be described as a very immiscible mixture, the constituents of which

exhibit low water solubility. This results in separate liquid phases (i.e., product/ water).

The viscosity of the product was measured by Herguth Laboratories in June 1991 from a sample collected from MW-2. The viscosity was reported as 1699 Redwood. Research has shown that viscous residual product in excess of 25 percent of the soil pore volume may be trapped due to forces attributed to interfacial tension between the organic and water phases (Payatakes 1982). This residual saturation is left behind as the product moves down toward the water table.

The product's relative density at 15°C was 0.9672. Liquids lighter than water tend to spread laterally when they encounter the capillary fringe and the water table. As a result of the water table elevation fluctuations in response to seasonal recharge and the possible influence of local pumping wells, the zone potentially exposed to free product may extend over the entire range of such fluctuations. Such "coating" of the water table fluctuation zone is indicated by conditions observed in wells NMW-9, NW-2, and NMW-13. The distribution of product in this zone may be highly variable, ranging from residual amounts to fully saturated lenses. Much of the product may be redistributed with each cycle of the water table. The soil matrices within the two stratigraphic sequences identified on the boring logs and shown in the geologic cross sections (Figures 2 and 3, Appendix B) are not homogeneous. Therefore, the geometric distribution of the contaminant zone is probably much more complex than presented in our geologic cross sections. The concentration of HFO within the area of contamination shown on the figures in Appendix B probably range from near saturated soil at the water table in a small area below the point of release to undetectable at the estimated boundary of the HFO-contaminated soils.

A petroleum product sample was collected in January 1992 from monitoring well MW-2. The petroleum product sample was analyzed for VOCs, metals, pesticides/ PCBs, BNAs, and PAHs using SW-846 and the CLP methods as presented in the

Work Plan. The analytical results are presented in Appendix D and summarized in Table 4-1.

Four soil samples were collected from borings for wells NMW-9, NMW-10, NMW-13, and NMW-14. These samples were from depths of 23, 27, 29.5, and 39.0 feet BGS, respectively. The samples from borings NMW-9, NMW-10, and NMW-13 were analyzed for VOCs, BNAs, TPH, and metals. The sample from boring NMW-14 was analyzed for VOCs and BNAs only, as previously discussed in Section 2.5. The analytical results are presented in Appendix E and are summarized in Table 4-2. Results of these analyses indicate contaminants typically associated with HFO and adequately characterize the extent of contamination, as described in Appendix B.

5.0 REVIEW OF ALTERNATIVE REMEDIAL RESPONSES

Six alternatives were selected and screened to evaluate their potential for implementation as response actions to clean up, contain, or monitor HFO in the subsurface. This section describes the alternatives and presents some considerations with respect to their implementation and effectiveness that can be used to judge their overall potential benefits.

The screening for potential cleanup alternatives included evaluation of technical effectiveness, ability to be implemented, and cost. Primary emphasis is given to effectiveness and the ability to be implemented.

The decision to investigate further is based on two factors:

- Demonstrated success of the technology or similar technologies.
- Site conditions that influence the use of the technology.

Cost estimates for each of the alternatives are presented at the end of this section. These costs are preliminary order magnitude estimates and are intended to present relative costs of one technology to another. Since the technical effectiveness of several of the alternatives are unknown, the costs assume that remediation can be successfully accomplished within a reasonable time frame. Actual costs to accomplish remediation may vary significantly from those presented herein.

5.1 MONITORING

Description: Periodic (i.e., quarterly) groundwater monitoring at wells surrounding the hydrocarbon product zone would be used to detect floating product and

dissolved constituent migration at the Amsted property boundary. Periodic (i.e., quarterly) measurements would be made to determine the presence or absence of floating product in wells MW-2, NMW-9, and NMW-13. Verification that dissolved constituents are not migrating from the Amsted property and contaminating the aquifer would be made by periodic sampling and laboratory analysis of groundwater samples from wells surrounding the former UST location. Any product accumulating in the wells would be removed, if feasible, from the well after its thickness is measured.

Technical Effectiveness: Periodic monitoring for the presence of HFO floating on the groundwater would provide a means of monitoring whether appreciable HFO quantities are being released from the soil. Collection and analysis of groundwater samples from wells surrounding the former UST location would provide a reasonable early warning mechanism to detect dissolved HFO constituents which indicate increased solubilization and/or movement of such compounds and can trigger a response action.

Technical Ability to be Implemented: Monitoring and testing can be easily implemented.

Cost: $40,000 (first year - see cost estimate at end of section).

Investigate Further: Yes.

Justification: Based on the available groundwater monitoring data, the area affected by this product release is isolated, and beneficial uses of groundwater do not appear to be threatened.

5.2 PUMP AND TREAT

Description: One or more recovery wells installed through the floating product zone would be used to remove product from the subsurface. Two wells that could be used for recovery were constructed as part of preceding investigations. The designs used for these wells were chosen to facilitate their use for the collection of HFO. Pumping of either HFO only, or water and HFO, would be initiated. Water/HFO separation would be achieved in aboveground vessels. Water would be treated and discharged to the sanitary sewer or reinjected into the ground. HFO would be collected for offsite disposal. [Displacement of contaminants from the soil pore space by steam injection may be combined with pumping (Section 5.6 - Steam Injection and Steam Extraction)].

Technical Effectiveness: Various pumping systems and treatment technologies that involve using wells to remove the HFO from the subsurface were originally regarded as feasible for the former UST location at the Amsted property. NMW-13, the 6-inch diameter recovery well, was installed and then periodically pumped or bailed and observed to evaluate the feasibility of this technology. The recharge rate of product into a well after product removal and the thickness of the floating product in the well after nearly steady-state conditions are reached on the recharge cycle, are indicators of how successful the use of a particular well will be for product recovery. Over a month after initially attempting to bail product from monitoring well NMW-13, a recoverable quantity of product still had not collected inside the well. It is apparent from these findings that the use of a recovery system that pumps water and HFO, or HFO only, at low rates is not feasible at this site.

Creating a cone of depression in the water table to induce product to flow toward the recovery well is not practical. The HFO is extremely viscous and would only be induced to move (at an effective rate) in response to a very steep hydraulic gradient. Given the hydraulic conductivity of the sediments comprising the upper-most saturated zone beneath the product layer, the groundwater pumping rate that would be required to induce a cone of depression sufficiently steep to induce

product flow to the recovery well would be excessive. This conclusion was reached after calculating HFO flow velocity, using data from pumping tests conducted in December 1991, along with the laboratory data from the sample of HFO collected from monitoring well MW-2 in May 1991. Two pumping tests were conducted during the STF project on wells NMW-3 and NMW-4. The pumping tests were run for 50 and 48 hours each. The pumping rate for both tests was 60 gpm. Drawdown measurements for the pumping wells and the observation wells were recorded. The measurements selected for use in the theoretical product recovery calculation were from the end of the pumping test, when drawdown was greatest. Assuming a constant slope of the water table surface between the pumping wells and the observation well, a hydraulic gradient of 0.151 was created during the first test, and a hydraulic gradient of 0.1755 was created during the second test. Equations derived from Darcy's Law were used in the theoretical product recovery calculation, and the hydraulic gradients given above were used to calculate the product movement rate that would be induced by groundwater pumping at these rates. The kinematic viscosity reported in the laboratory analysis of the HFO sample collected from MW-2 was used in the equation. Factors for hydraulic conductivity and porosity were selected based on the known soil types and were used in the calculation. The results of this calculation indicate that with the gradient created by pumping at a rate of 60 gpm, HFO will move about 24 feet per year. At a pumping rate of 60 gpm, over a one-year period, the volume of water pumped would be approximately 31.5 million gallons.

The type of estimate presented above is imprecise because the assumptions made oversimplify the actual conditions in the subsurface. However, this estimate shows that creating a cone of depression adequate to induce HFO to flow is not a practical product recovery method. In addition, creating a deep cone of depression may permit product to be "smeared" onto sediments deeper in the saturated zone. Such smearing can decrease the volume of recoverable product and potentially adversely affect groundwater quality.

Technical Ability to Implement: Two logistical problems that would be encountered in implementation of this technology are discussed below.

The first problem is disposing of water separated from the HFO or water pumped to create a cone of depression.

Options generally considered for water disposal are:

- Discharge to a sanitary sewer
- Reinjection
- Collection, offsite transportation, and disposal
- Discharge to surface water under a National Pollutant Discharge Elimination System (NPDES) permit.

All four options have been successfully used at other sites. Disposal in a sanitary sewer initially appears best because of the relatively short distance from the wells to the sanitary sewer on the west side of the property. However, the results of recent inquiries to the City of Tacoma Department of Public Works concerning disposal of water from subsurface recovery operations into the sanitary sewer system have not been favorable. At the least, the review and approval process will be lengthy. Therefore, the cost estimate for this remedial response and all others presented use offsite water disposal. Reinjection or discharge to surface water, although appearing technically feasible, may require extensive monitoring and obtaining permits may be difficult. Transportation and disposal costs for offsite disposal would have a much higher unit cost than the other two methods.

The second problem is that electrical power is not available on the property and will require reinstallation. Electrical power lines that in the past provided power to the foundry were removed or not maintained and are no longer in service. Electrical

power is provided to adjacent businesses, and the old poles may be reused to reestablish power from lines that serve the adjacent businesses.

Cost: $534,000 (see cost estimate at end of section).

Investigate Further: No.

Justification: The thin layer of product in the vicinity of MW-2 is not amenable to removal by automated skimming (low-rate pumping) systems. These systems will not draw HFO into the wells. Anticipated groundwater pumping rates required to produce adequate drawdown to induce product flow to recovery wells are high. Large volumes of water would be removed from the groundwater system and would not likely be replaced. The potential risks to human health and the environment posed by the type and quantity of floating hydrocarbon product on the water table do not justify removing large quantities of water to effect minimal product recovery.

5.3 BIOREMEDIATION

Description: Bioremediation refers to the bio-oxidation or other biotransformation of organic matter by microorganisms (EPA 1988e). Bioremediation involves introducing bacteria or relying on native bacteria to decompose the hydrocarbon product. The rate at which the bacteria decompose the product is dependent on the availability of oxygen and nutrients. Soil bioremediation can occur aboveground as well as in situ, although aboveground treatment is the more common treatment method (Kaufman 1989). In the aboveground method, soil is placed on a pad in lifts of 1 to 3 feet. A water delivery system typically is used to moisten the soil, and microorganisms and/or nutrients are added, if necessary. The soil is tilled regularly to mix the microorganisms, nutrients, and water to promote efficient contaminant degradation.

In situ bioremediation is commonly used to concurrently treat contaminated soil and groundwater. The inoculum and nutrients (aqueous mix) are delivered to the subsurface via injection or infiltration galleries and percolate through the vadose zone to the water table, coating contaminated soil as the mix moves through the subsurface. The groundwater is then recovered via extraction wells, pumped to the surface, and treated in aboveground bioreactors and/or activated carbon. The treated water is then reinjected or discharged (Kaufman 1989).

Technical Effectiveness: Bioremediation is a proven technology for a variety of contaminants including petroleum hydrocarbons; however, its potential effectiveness in remediating in situ soil zones saturated by heavy hydrocarbon mixtures is expected to be very limited.

Technical Ability to be Implemented: In situ bioremediation does not appear advantageous due to the conditions in the subsurface and the type of hydrocarbon product released. Some of the problems and conditions that limit the potential usefulness of in situ bioremediation at the Amsted site are listed below.

- The depth of HFO from the surface (over 30 feet) as well as the highly viscous nature of the product reduce the possibility of a controlled introduction and verifiable distribution of bacteria, oxygen, and nutrients into the HFO saturated zone.

- Nutrient solution may leach into the groundwater and pose a contamination threat to that media.

- The process would be slow and probably require a significant number of new borings to inject nutrients and supply oxygen.

- Achieving hydraulic control of subsurface water may require pumping large quantities of water (Section 5.2 - Pump and Treat).

- There is no guarantee that the method would be effective, and another solution (another technology) may be required to complete the remedial action objectives.

Cost: $923,000 (see cost estimate at end of section).

Investigate Further: No.

Justification: In situ bioremediation may not be effective with high-viscosity product in soil except where concentrations of the product are low enough to allow penetration and contact of the bacteria and nutrients with the product. Introduction of bacteria and nutrients into the saturated product zone is expected to be difficult. Controlling the migration of groundwater containing mobilized hydrocarbons and nutrients in the subsurface would be difficult and could lead to the contamination of surrounding sites.

5.4 EXCAVATION

Description: Excavation involves the use of mechanical equipment to remove contaminated soil for offsite disposal. The equipment may include tracked back-hoes, front-end loaders, clam shells, and dump trucks.

Technical Effectiveness: Backhoes and clam shells are suitable for excavating soil from the site.

Technical Ability to be Implemented: Three significant problems would be encountered using excavation as a means of remediating HFO-contaminated soils. First, surface soils in the former UST area contain elevated levels of lead and other metals. This contaminated soil is being addressed under the ongoing STF project. At this time, the findings of the STF Remedial Investigation/Feasibility Study (RI/FS) with respect to soil containing metals in this area are not available for review and

incorporation into this review of technologies. If excavation was to be considered as a viable response to the HFO contamination, integration of the remedial action for metals-contaminated soils at Amsted developed during the STF RI/FS, with an excavation remedial response to the HFO release, would appear to be logical due to the low migratory potential associated with the HFO. Two possible scenarios are presented below.

- Surface soils containing elevated concentrations of metals could be excavated and stockpiled. Uncontaminated soil below the surface soil and above the zone of petroleum-contaminated soil could be excavated and stockpiled separately. HFO-contaminated soil could be excavated and replaced with clean imported fill. The uncontaminated soil could be put back in place and the surface soil containing elevated levels of metals would also be put back in place. Areas of the Amsted property with surface soil containing elevated metals concentrations might then be capped with a low-permeability cover.

- The soils containing elevated levels of metals would be excavated and stockpiled for offsite disposal, or they would be immediately trucked to a disposal facility. Immediate disposal would reduce the number of times the soil requires special handling.

The second significant technical problem is performing controlled excavation work to depths in excess of 30 feet BGS. The following considerations are important if excavation were to be performed.

- The soil zone containing appreciable concentrations of HFO is as much as 10 or 12 feet thick (vertically) near the point of release. The bottom of this zone is at, or slightly below, the lowest recorded water table level. An excavation to remove soils would encounter the water table. Product floating on the groundwater surface is likely to occur directly below or close to its point of release. Therefore, product and groundwater would

have to be pumped from the excavation for disposal. A plan for placing, moving, and removing the recovery and excavation equipment would be required.

- Excavation is limited to approximately 20 feet because of the requirement of 1:1 (vertical:horizontal) side slopes. A hydraulic excavator can excavate more than 20 feet BGS by digging a bench to work from, and then moving down to the bench. This, however, requires a significantly larger excavation.

- Installation of sheet piles and excavation with a clam shell bucket could be used instead of excavating with a hydraulic excavator. Sheet piles would be driven to form a continuous wall around the area of contamination and then braced horizontally at several levels. This method minimizes the area and volume of soil removal, but is slower than excavating with a hydraulic excavator. Installation and bracing of sheet piles would also add considerable cost to the operation.

The third significant technical problem is in performing the work with methods that pose less threat to site workers than the risks associated with other actions. Excavation and cleanup activities at the depths required to remove the HFO at this property require construction using large heavy machinery, and methods or equipment to reduce the possibility of slope failures. The risks associated with this type of construction work are probably far greater than for the potential risks from chemical exposure.

Cost: $3,197,000 (see cost estimate at end of section). The cost estimate is based on offsite disposal of lead, petroleum contaminated soil, and water from excavation activities. The method employing sheet piling was selected for the estimate because it requires less disturbance of lead contaminated soils at the surface and can probably be implemented without impacting adjacent property.

Investigate Further: No.

Justification: While excavation equipment is well-suited to removing contaminated soil for offsite disposal or aboveground treatment, and soils containing HFO could be completely removed, there are significant economical and technical concerns related to this approach, as discussed above.

The excavation cost to remove the HFO-contaminated soil would be very high because of the depth of the contaminated zone and other site constraints. The cost and short-term risks to site workers incurred from excavation would be excessive when compared to the benefits derived.

5.5 CUTOFF

Description: A cutoff is a vertical wall of relatively impermeable material that surrounds the floating product. The wall extends vertically below and above the water table, beyond the limits of the water table seasonal fluctuation. A cutoff is constructed of earth, steel sheet piling, concrete, curtain of grout, cement/bentonite slurry, or a combination of these materials. The materials of construction and their thickness are selected for their low permeability and non-reactive characteristics, and are designed to impede the horizontal movement of product and/or groundwater. The installation procedures vary with the materials selected, but commonly include drilling with an auger and pumping a slurry through the auger or a tremie pipe. Steel interlocking sheet piles are often driven without the use of grouts or they may be driven down through a grout curtain. Grout curtains are often softer than the surrounding formation and are free of rocks and boulders.

The problems involving surface soil containing elevated levels of metals discussed in Section 5.4 - Excavation, are also applicable to this technology.

Technical Effectiveness: Cutoffs have low permeability and would inhibit floating product or dissolved constituents from moving horizontally. Because of the remote method of grout placement, however, it may not be possible to ensure the hydraulic integrity of a grout curtain.

Technical Ability to be Implemented: Cutoffs have been used successfully in many applications for containment of contaminants and groundwater. The depth required for installation is in excess of 35 feet. Technical problems may include control of heaving sands and maintaining precise control of the auger position to construct a curtain that completely covers the vertical plane to be sealed.

Cost: $1,973,000 (see cost estimate at end of section).

Investigate Further: No.

Justification: Containment using a cutoff technology is difficult to achieve at the required depth, and the effectiveness cannot be guaranteed. While cutoffs have been demonstrated to be effective in reducing the horizontal movement of contaminated groundwater, some of the same risks (e.g., worker exposure, etc.) associated with excavation would be apparent with this alternative. In addition, groundwater sampling results and the potential for migration of HFO in soil does not appear to warrant the use of a cutoff to address the contamination.

5.6 STEAM INJECTION AND STEAM EXTRACTION

Steam Injection Description: Steam injection has been used successfully for many years to enhance the recovery of petroleum from depleted oil and gas fields. The technology involves the introduction of steam under pressure into the target geologic formation, and the extraction of the petroleum product that is mobilized (in response to the steam injection) at a withdrawal well(s). Mobility of the petroleum product left at residual saturation in the porous geologic media is increased in

response to heating and, to some extent, physical displacement by water. The mobilized product moves in response to thermal and pressure gradients to the point of extraction. In this case, mobilized petroleum product would migrate both vertically (to the water table) and horizontally and would be extracted in conjunction with groundwater pumping. Application of the technology for groundwater cleanups is somewhat rare, and use of steam injection at the Amsted property would be regarded as experimental.

Steam Stripping Description: Two counter-rotating hollow-stem auger drills inject steam and air into contaminated soil to depths of up to 30 feet BGS. The soil temperature rises, causing the vapor pressure of the volatile organic contaminants to increase. The injected air and steam carry the contaminants to the surface and transport them to a condenser that liquifies the vapors. A distillation system separates volatile organic contaminants from the water. The water is then filtered through activated carbon and used again in the steam process. Activated carbon is also used for collecting the volatile organic vapors.

Technical Effectiveness: Steam injection and steam stripping are innovative technologies. Details regarding technical effectiveness were not available.

Technical Ability to be Implemented. The technical implementation of this remedial method is impacted by soil permeability, moisture content, and organic content. Testing would be required to determine whether steam extraction can be successfully implemented at the site.

Cost: $3,243,000 (see cost estimate at end of section).

Investigate Further: No.

Justification: These innovative process options lack adequate performance records to accurately judge their potential effectiveness.

5.7 CONCLUSION

The remedial action that provides appropriate protection for human health and the environment given existing site conditions appears to be groundwater monitoring. This response action was selected for the following reasons.

- Laboratory analyses indicate that concentrations of groundwater contaminants are below drinking water standards throughout the site, including wells directly impacted by HFO. Therefore, the threat to human health appears minimal.

- Floating HFO was not detected on the water table although globules of HFO were present in a few of the wells. Pumping alone will not remove the HFO trapped in the soil.

- Site conditions would limit the effectiveness of bioremediation, steam injection, and steam extraction. These technologies have not been well demonstrated and may have potential risks that exceed the risks of a no-action alternative.

- The costs for excavation of the HFO-contaminated soil are estimated to be very excessive compared to the benefit derived from a removal action.

If the HFO or its constituents become mobile and have the potential to migrate offsite, then the technologies presented in this section should be reexamined. Periodic groundwater sampling and analysis of selected samples should provide adequate information for determining the need for future remedial action.

COST ESTIMATES FOR REMEDIAL ALTERNATIVES

PRELIMINARY COST ESTIMATE
MONITORING

AMSTED INDUSTRIES	CONSTRUCTION COST ESTIMATE				KJ 916058.00		DATE
SUBSURFACE FUEL INVESTIGATION	PRELIMINARY TAKE-OFF'S				AMS_MON.wk1		24-Nov-92
PROJECT:	ORDER-OF-MAGNITUDE		PRICE LEVEL		TAKE OFF:		APVD:
CLIENT: AMSTED INDUSTRIES	COST ESTIMATE				ESTIMATOR: OGL		CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Quarterly Monitoring (1 year)								
	Labor (9 wells)	128	HR			$65	$8,320		$8,320
	Sampling Vehicle	8	DAY			$625	$5,000		$5,000
	Misc. Supplies	4	EA	$200	$800				$800
	Drums	18	EA	$45	$810				$810
	Water Disposal	14	LS					$1,000	$1,000
	Well Pumps & Tubing	7	EA			$1,260	$8,820		$8,820
	Laboratory Testing								
	TPH, PNA	40	EA			$220	$8,800		$8,800
	Wells NMW-8, NMW-9, NMW-10 NMW-11, NMW-12, NMW-13 NMW-14, Duplicate, Blank								
	Monthly Reporting & Data Management								
	Lab Data (4 Reports @ 6 Hr/Report)	24	HR			$83	$1,992		$1,992
	Water Table Contour Map (4 Maps @ 3 Hr/Map)	12	EA			$65	$780		$780
	Computer Fees	12	HR			$20	$240		$240
	Word Processing	10	HR			$45	$450		$450
	SUBTOTAL								$37,000
	Washington State Sales Tax	7.8%						$2,886	$2,886
	ENGINEER'S ESTIMATE								$40,000

PRELIMINARY COST ESTIMATE
PUMP & TREAT

AMSTED INDUSTRIES	CONSTRUCTION COST ESTIMATE	KJ 916058.00	DATE
SUBSURFACE FUEL INVESTIGATION	PRELIMINARY TAKE-OFF'S	AMS_PUMP.wk1	24-Nov-92
PROJECT:	ORDER-OF-MAGNITUDE / PRICE LEVEL	TAKE OFF:	APVD:
CLIENT: AMSTED	COST ESTIMATE	ESTIMATOR: OGL	CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Site Work								
	Containment Berm	2,000	SQFT	$0.75	$1,500				$1,500
	Containment Excavation	148	CY			$5.75	$851		$851
	Backfill Sand	37	CY	$12	$444	$12	$444		$888
	Special Construction								
	Product Holding Drums	6	EA	$50	$300				$300
	Oil/Water Seperator	1	EA					$12,000	$12,000
	Water Holding Tank	1	EA	$4,000	$4,000	$3,500	$3,500		$7,500
	Well Drilling							$15,000	$15,000
	Equipment Building	144	SQFT	$15	$2,160	$15	$2,160		$4,320
	Mechanical								
	Exposed Piping & Valves	1	LS	$3,000	$3,000	$3,000	$3,000		$6,000
	Pumps & Controls	4	EA	$2,600	$10,400				$10,400
	Compressor	1	EA	$3,500	$3,500				$3,500
	Electrical Instrumentation								
	Power Drop w/350' Overhead	1	LS					$14,500	$14,500
	Site Electrical	1	LS					$8,000	$8,000
	Control Panel							$3,500	$3,500
	Construction Oversight							$9,960	$9,960
	SUBTOTAL								$98,000
	Bond & Insurance	1.0%						$980	$980
	Mobilization	3.0%						$2,940	$2,940
	Overhead & Profit	10.0%						$9,800	$9,800
	Contractors Contingency	5.0%						$4,900	$4,900
	Field Administration	1.0%						$980	$980
	Health & Safety Premium	25.0%						$24,500	$24,500
	CONSTRUCTION COST SUBTOTAL								$142,000
	OTHER COSTS								
	System Design							$15,000	$15,000
	System Operation	832	HR			$27	$22,464		$22,464
	Water Disposal (off-site)	1,051,200	GAL			$0.30	$315,360		$315,360
	SUBTOTAL								$495,000
	Washington State Sales Tax	7.8%							$38,610
	ENGINEER'S ESTIMATE								$534,000

PRELIMINARY COST ESTIMATE
BIOREMEDIATION

AMSTED INDUSTRIES	CONSTRUCTION COST ESTIMATE	KJ 916058.00	DATE
SUBSURFACE FUEL INVESTIGATION	PRELIMINARY TAKE-OFF'S	AMS_BIO.wk1	14-Dec-92
PROJECT:	ORDER-OF-MAGNITUDE / PRICE LEVEL	TAKE OFF:	APVD:
CLIENT: AMSTED	COST ESTIMATE	ESTIMATOR: OGL	CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Well Installation								
	Locate Utilities	1	LS			100.00	$100		$100
	Drilling	180	LF			15.00	$2,700		$2,700
	Installation	20	HR			140.00	$2,800		$2,800
	Geologist	32	HR			82.00	$2,624		$2,624
	PVC Pipe, Casing	180	LF	9.00	$1,620				$1,620
	Drums, Containers	12	EA	45.00	$540				$540
	Electrical								
	Power Drop & Service							$14,500	$14,500
	Control Panel							$2,500	$2,500
	Site Electrical							$4,000	$4,000
	Electricity	10,000	KWH			0.17	$1,700		$1,700
	SUBTOTAL								$33,000
	Bond & Insurance	1.0%						$330	$330
	Mobilization	3.0%						$990	$990
	Overhead & Profit	10.0%						$3,300	$3,300
	Contractors Contingency	5.0%						$1,650	$1,650
	Field Administration	1.0%						$330	$330
	Health & Safety Premium	25.0%						$8,250	$8,250
	CONSTRUCTION COST SUBTOTAL								$48,000
	OTHER COSTS								
	Bioremediation Process								
	Process Development	1	LS					$15,000	$15,000
	Labor	600	HR			80.00	$48,000		$48,000
	Process (4 GPM)	2,102,400	GAL			0.25	$525,600		$525,600
	Operations & Maintenance								
	Water Supply	2,102,400	GAL			0.001	$2,102		$2,102
	Pump O & M	1	LS			750.00	$750		$750
	(% of material cost)								
	Sampling								
	Groundwater Sampling	96	EA			500.00	$48,000		$48,000
	Disposal of Contaminated Soil	12	EA			325.00	$3,900		$3,900
	Sampling and Analysis Plan							$5,000	$5,000
	Confirmational Soil Sampling	30	EA					$11,000	$11,000
	Engineering Services	20.0%						$141,470	$141,470
	(% of Subtotal)								
	Construction Services	15.0%						$7,200	$7,200
	(% of Subtotal)								
	CONSTRUCTION COST SUBTOTAL								$856,000
	Washington State Sales Tax	7.8%						$66,768	$66,768
	ENGINEER'S ESTIMATE								$923,000

PRELIMINARY COST ESTIMATE
EXCAVATION

AMSTED INDUSTRIES SUBSURFACE FUEL INVESTIGATION		CONSTRUCTION COST ESTIMATE PRELIMINARY TAKE-OFF'S		KJ 916058.00 AMS_EXCV.wk1	DATE 24-Nov-92
PROJECT: CLIENT: AMSTED	ORDER-OF-MAGNITUDE COST ESTIMATE	PRICE LEVEL:	TAKE OFF: ESTIMATOR: OGL		APVD: CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Sheet Piling	243	TON	$895	$217,754	$378	$91,967		$309,721
	Shoring of Sheet Piling (% of Sheet Piling)	15.0%							$48,458
	Concrete Demolition								
	Floor	1,500	SQFT			$2.96	$4,440		$4,440
	Footing	110	LF			$9.19	$1,011		$1,011
	Saw Cut	50	LF			$16.00	$800		$800
	Excavation (35' Depth)	8,300	CY			$6.30	$52,290		$52,290
	Backfill- Haul (2 miles)	5,217	CY	$7	$36,519	$4.00	$20,868		$57,387
	Backfill- Reuse	3,083	CY			$4.88	$15,045		$15,045
	SUBTOTAL								$487,000
	Bond & Insurance	1.0%						$4,870	$4,870
	Mobilization	3.0%						$14,610	$14,610
	Overhead & Profit	10.0%						$48,700	$48,700
	Contractors Contingency	5.0%						$24,350	$24,350
	Field Administration	1.0%						$4,870	$4,870
	Health & Safety Premium	25.0%						$121,750	$121,750
	CONSTRUCTION COST SUBTOTAL								$706,000
	OTHER COSTS								
	Water Disposal & Treatment	240,000	GAL			$0.35	$84,000		$84,000
	Pump Rental							$2,000	$2,000
	Soil Disposal								
	Lead Contaminated	2,609	CY			$515	$1,343,635		$1,343,635
	Oil Contaminated	2,609	CY			$109	$284,381		$284,381
	Sampling & Analysis Plan							$5,000	$5,000
	Engineering Services (% of Total Cost)	20.0%						$485,003	$485,003
	Construction Services (% of Construction Cost)	8.0%						$58,480	$58,480
	SUBTOTAL								$2,966,000
	Washington State Sales Tax	7.8%							$231,348
	ENGINEER'S ESTIMATE								$3,197,000

PRELIMINARY COST ESTIMATE
CUTOFF

AMSTED INDUSTRIES	CONSTRUCTION COST ESTIMATE	KJ 916058.00	DATE
SUBSURFACE FUEL INVESTIGATION	PRELIMINARY TAKE-OFF'S	AMS_CUT.wk1	24-Nov-92
PROJECT:	ORDER-OF-MAGNITUDE PRICE LEVEL	TAKE OFF:	APVD:
CLIENT: AMSTED	COST ESTIMATE	ESTIMATOR: OGL	CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Concrete Demolition								
	Floor	1,500	SQFT			$2.96	$4,440		$4,440
	Footing	110	LF			$9.19	$1,011		$1,011
	Saw Cut	50	LF			$16.00	$800		$800
	Excavation (Lead Contaminated)	1,422	CY			$1.57	$2,233		$2,233
	Soil Hauling and Disposal	1,422	CY			$515	$732,330		$732,330
	Fill & Place Cement	5,520	FT	$12	$66,240	$20	$110,400		$176,640
	Backfill w/Import Fill	1,422	CY	$7	$9,954	$4	$5,688		$15,642
	Sheet Piling	243	TON	$715	$173,960	$153	$37,225		$211,184
	SUBTOTAL								$1,144,000
	Bond & Insurance	1.0%						$11,440	$11,440
	Mobilization	3.0%						$34,320	$34,320
	Overhead & Profit	10.0%						$114,400	$114,400
	Contractors Contingency	5.0%						$57,200	$57,200
	Field Administration	1.0%						$11,440	$11,440
	Health & Safety Premium	25.0%						$286,000	$286,000
	CONSTRUCTION COST SUBTOTAL								$1,659,000
	OTHER COSTS								
	Sampling & Analysis Plan							$5,000	$5,000
	Engineering Services (% of Total cost)	10.0%						$166,400	$166,400
	SUBTOTAL								$1,830,400
	Washington State Sales Tax	7.8%							$142,771
	ENGINEER'S ESTIMATE								$1,973,171

PRELIMINARY COST ESTIMATE
STEAM INJECTION

AMSTED INDUSTRIES	CONSTRUCTION COST ESTIMATE	KJ 916058.00	DATE
SUBSURFACE FUEL INVESTIGATION	PRELIMINARY TAKE-OFF'S	AMS_SI.wk1	24-Nov-92
PROJECT:	ORDER-OF-MAGNITUDE PRICE LEVEL	TAKE OFF:	APVD:
CLIENT: AMSTED	COST ESTIMATE	ESTIMATOR: OGL	CHKD:

DIV NO.	TASK DESCRIPTION	QUANTITY NUMBER UNITS	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR & EQUIPMENT UNIT COST	LABOR & EQUIPMENT EXTENSION	SUB CONTRACT PRICE	TOTALS
	Site Work								
	Recovery trench construction	3,267	CY			$4	$13,068		$13,068
	Backfill w/import	2,133	CY	$7	$14,931	$4	$8,532		$23,463
	Containment berm w/liner							$3,500	$3,500
	PVC slotted recovery pipe	90	LF	$12	$1,080	$8	$720		$1,800
	Blank casing	105	LF	$10	$1,050	$10	$1,050		$2,100
	Soil disposal (Lead Contaminated)	2,133	CY			$515	$1,098,495		$1,098,495
	Special Construction								
	Oil/water Seperator	1	EA					$12,000	$12,000
	Water holding tank	1	EA	$4,000	$4,000	$3,500	$3,500		$7,500
	Equipment building	144	SQFT	$15	$2,160	$15	$2,160		$4,320
	Steam injection wells	225	LF	$20	$4,500	$40	$9,000		$13,500
	Boiler							$9,000	$9,000
	Mechanical								
	Exposed piping valves	1	LS					$6,000	$6,000
	Pumps & controls	1	LS					$3,000	$3,000
	Electrical Instrumentation								
	Power drop w/350' overhead & Service Entrance Panelboard	1	LS					$14,500	$14,500
	Site electrical	1	LS					$6,000	$6,000
	Control panel	1	LS					$4,500	$4,500
	Water header	1	LS					$1,500	$1,500
	SUBTOTAL								$1,224,000
	Bond & Insurance	1.0%						$12,240	$12,240
	Mobilization	3.0%						$36,720	$36,720
	Overhead & Profit	10.0%						$122,400	$122,400
	Contractors Contingency	5.0%						$61,200	$61,200
	Field Administration	1.0%						$12,240	$12,240
	Health & Safety Premium	25.0%						$306,000	$306,000
	CONSTRUCTION COST SUBTOTAL								$2,999,000
	OTHER COSTS								
	System Design	1	LS					$18,000	$18,000
	Operating Costs	1,080	HR			$27	$29,160		$29,160
	Water Disposal	259,200	GAL			$0.30	$77,760		$77,760
	SUBTOTAL								$3,124,000
	Washington State Sales Tax	7.8%						$243,672	$243,672
	ENGINEER'S ESTIMATE								$3,243,000

6.0 SUMMARY AND RECOMMENDED ACTION

6.1 SUMMARY OF FINDINGS

The extent of hydrocarbon contamination in the soil at the site appears to be generally defined. This contamination appears limited to a small portion of the Amsted property, and the free product appears to be relatively immobile. Recoverable concentrations of free-floating product on the water table using conventional technologies are not apparent. Seasonal fluctuations of the water table probably redistribute the product spatially within the soil profile. Horizontal or downgradient migration of the product along the water table, if occurring, is likely very slow. Laboratory analysis of water samples collected from the wells on the property has shown that dissolved contaminants in the groundwater were detected at levels below those established for drinking water or at area background concentrations.

Initially, groundwater from seven surrounding wells, as well as well NMW-9 which is within the contaminated zone, was analyzed to assess the impact of the product release to groundwater. The impact appears to be minimal. An additional groundwater sample was recently collected from well NMW-13 and analyzed for VOCs, BNAs, PAHs, and TPHs. Again the laboratory results indicated the HFO in the subsurface has minimal impact on groundwater quality.

Historic site operations that used Bunker C fuel were discontinued in 1980, and the USTs were removed in 1990. The source of the product has been removed. Soil directly below the point of release, but above the water table, could be acting as a source of product to groundwater. The boring for recovery well NMW-13 contained soils that were contaminated with product above the zone of water table fluctuation. NMW-13 is probably located very close to the product release point. However, since NMW-13 does not contain a measurable thickness of product, it is

unlikely that this soil is a continuing source of free product to the water table. Downgradient migration of HFO has probably reached a steady-state condition, with most of the HFO retained in the soil pore space.

6.2 RECOMMENDED ACTION

The extent of HFO in the subsurface at the former Griffin Wheel Brass Foundry appears to have been defined. Based on field investigations, laboratory analyses of samples, and review of potential response actions, the following are the conclusions of this investigation.

- Effective recovery of any appreciable quantity of HFO found floating on the water table is either not possible using conventional technologies or could potentially spread more HFO into the saturated zone, thus increasing groundwater degradation.

- Groundwater samples collected from monitoring wells surrounding the product release and the area known to contain HFO in the soil did not contain dissolved constituents above primary drinking water standards or area background concentrations.

- Given existing site conditions, the effectiveness of in situ soil remediation technologies is uncertain since the technologies generally lack a performance record to help justify their effectiveness.

- The excavation cost to remove the HFO-contaminated soil would be very high because of the depth of the contaminated zone and other site constraints. The cost and short-term risks to site workers incurred from excavation would be excessive when compared to the benefits derived.

Based on the foregoing conclusions, it appears that long-term monitoring of groundwater is the most appropriate action for the HFO contamination in soil and groundwater.

A sampling, analysis, and reporting plan that addresses analytical parameters of concern, analytical methods, sampling frequencies, and reporting procedures should be developed. Based on the findings, a groundwater monitoring program that includes water sampling and analysis from wells NMW-8, NMW-10, NMW-11, NMW-12, and NMW-14 should be initiated as a means of detecting possible migration of dissolved petroleum constituents in the uppermost saturated zone. Wells NMW-9, NMW-13, and MW-2 should be monitored for the presence of floating product. Further study of potential cleanup methods, as discussed in Section 5.0, would be needed if there is movement of the product, changes in the site conditions, or activities that affect the product and the integrity of the water quality of the aquifer. Sampling frequencies should be selected based on both estimated groundwater velocities and the results of the prior monitoring events. The plan should also contain provisions for developing and selecting remediation technologies if water quality at the property boundary degrades below drinking water standards.

The property boundary should be an appropriate part of compliance since Amsted anticipates the property will continue to be used for industrial use. Amsted could institute land use controls to guarantee future use as an industrial property.

7.0 REFERENCES

Kaufman, A.K. 19 April 1989. "Applied Bioremedial Technology: Proceedings from HAZMACON '89." Thorne Environmental.

Kennedy/Jenks/Chilton. 1991a. South Tacoma Field QAPjP. Final Report.

Kennedy/Jenks Consultants. 1992. Work Plan, Well Installation and Monitoring, Former Griffin Wheel Brass Foundry, Tacoma, Washington. Prepared for Amsted Industries, Chicago, Illinois.

Payatakes A.C. 1982. Dynamics of Oil Ganglia During Immiscible Displacement in Wet Porous Media. Ann. Rev. Fluid Mech. 14, 365-393.

U.S. Environmental Protection Agency. 1988a; 1990a,b. Contract Laboratory Program Statements of Work. Kennedy/Jenks Consultants 1991a. South Tacoma Field QAPjP.

U.S. Environmental Protection Agency. 1988b,c,d; Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganics Analyses. The US EPA Data Review Work Group.

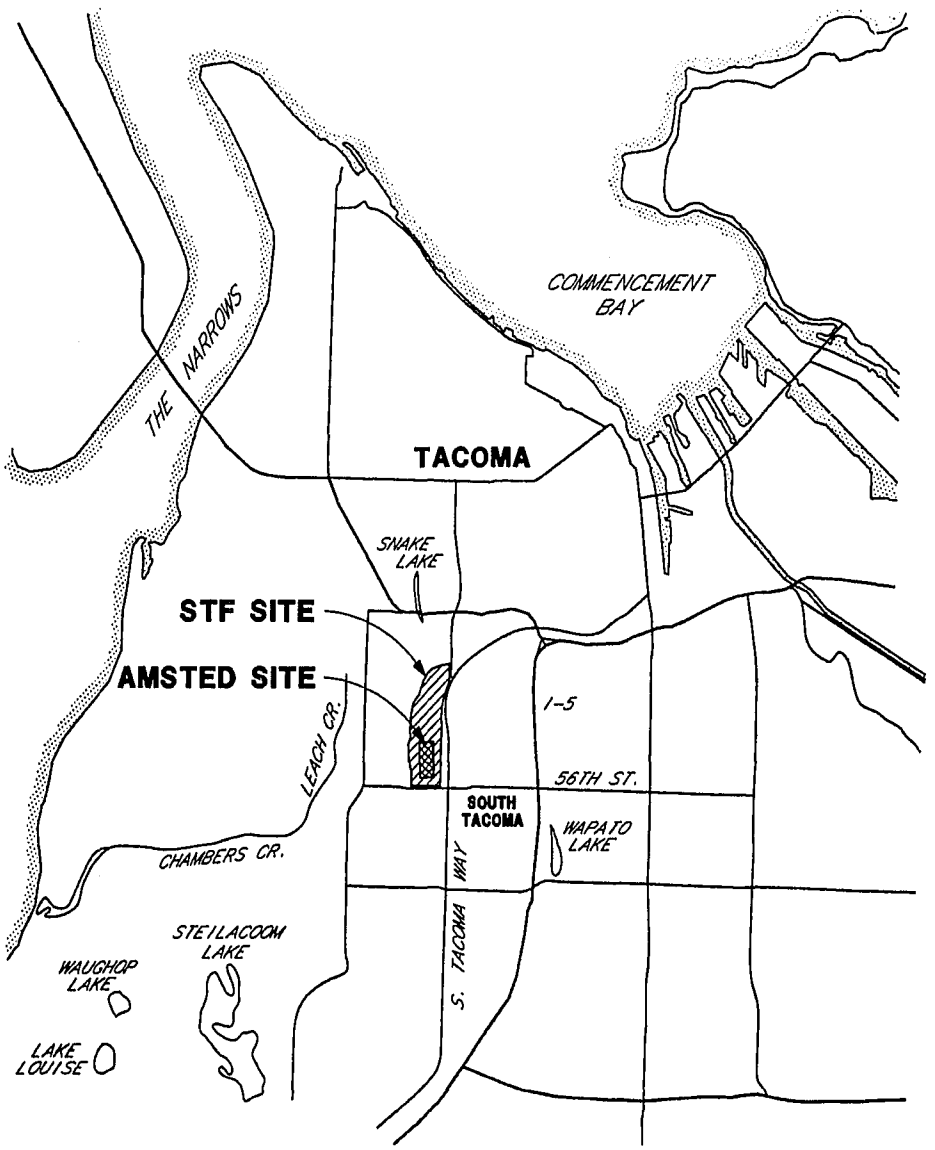
U.S. Environmental Protection Agency. 1988e. "Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA." U.S. Environmental Protection Agency Report 540/G-89/004.

U.S. Environmental Protection Agency. 1991. EPA Region 10 Supplemental Risk Assessment Guidance for Superfund, 16 August 1991.

U.S. Environmental Protection Agency. 1992. Selection of Chemicals in Surface Soil and Air; prepared by ICF Technology Incorporated. Presented 4 May 1992 to the South Tacoma Field Group and Kennedy/Jenks Consultants. Ms. Christine Psyk, Site Manager, U.S. EPA, Region 10, Seattle, WA.

Appendix A

Site Map



Kennedy/Jenke Consultants

AMSTED INDUSTRIES
CHICAGO, IL

SITE LOCATION MAP

916058.00/P1SK001

FIGURE 1

Appendix B

Partial Plan: Amsted Property
Geological Cross Sections

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

OVERSIZED DOCUMENT

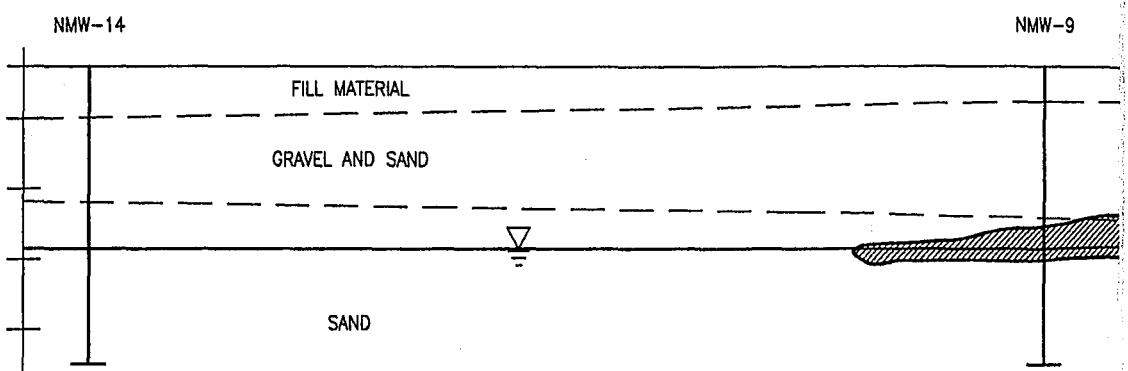
The page that occupies this position in the Administrative Record is:

Document Number: 2.6 1021692

Document Description: FIGURE 1
SUBSURFACE INVESTIGATION

This document may be examined upon request at:

U.S. Environmental Protection Agency
Region 10
Superfund Records Center
1200 Sixth Avenue, ECL-076
Seattle, WA 98101-1128
(206) 553-4494

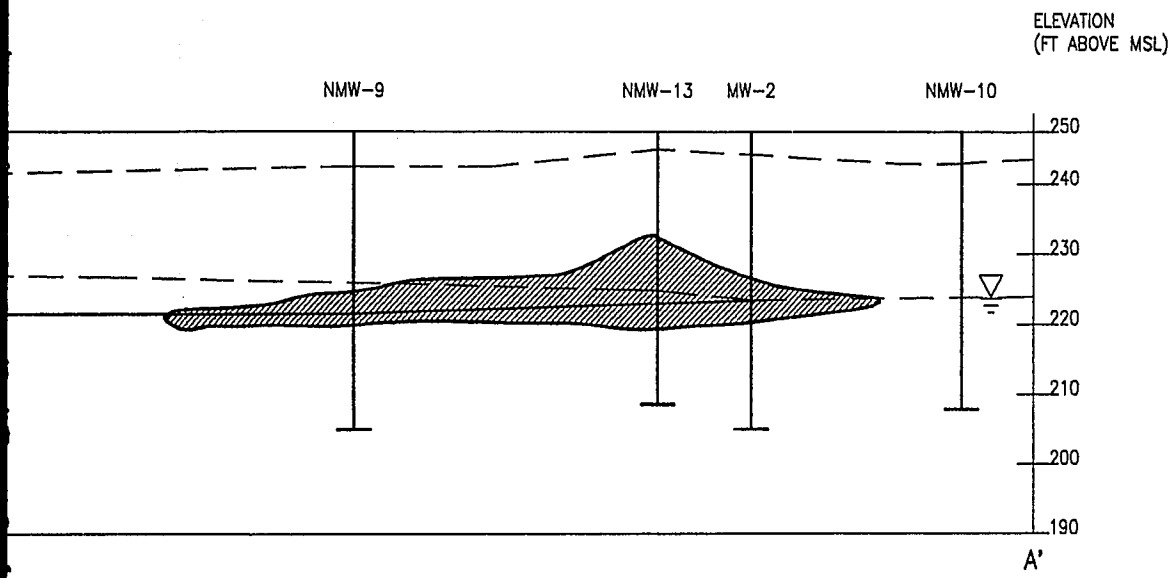


SCALE: 1"=20' FEET

— — CONTACT, APPROXIMATE

ESTIMATED WATER TABLE SURFACE AT THE TIME OF WELL INSTALLATION

ESTIMATED EXTENT OF BUNKER "C" FUEL OIL IN SOIL



SCALE: 1"=20' FEET

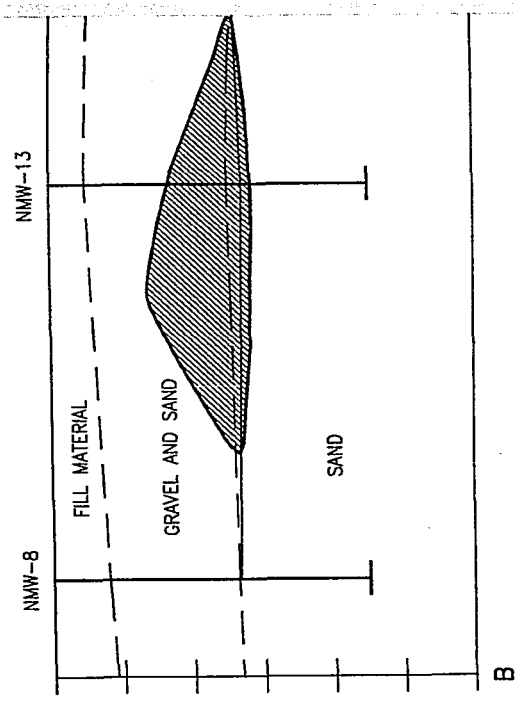
Kennedy/Jenks Consultants

AMSTED INDUSTRIES
TACOMA, WA

CROSS SECTION A-A'

916058.00/P2SK002

FIGURE 2

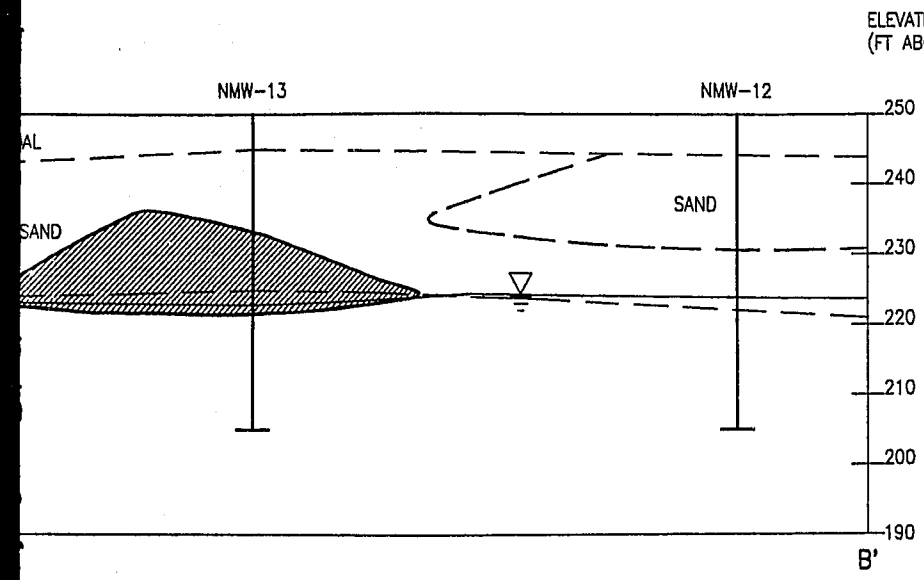


SCALE: 1"=20' FEET

— — CONTACT, APPROXIMATE

ESTIMATED WATER TABLE SURFACE AT THE TIME OF WELL INSTALLATION

ESTIMATED EXTENT OF BUNKER "C" FUEL OIL IN SOIL



SCALE: 1"=20' FEET

MATE

TABLE
TIME OF

OF
OIL IN SOIL

Kennedy/Jenks Consultants

AMSTED INDUSTRIES
TACOMA, WA

CROSS SECTION B-B'

916058.00/P2SK003

FIGURE 3

Appendix C

Boring and Well Construction Logs
NMW-8 Sieve Analysis

MONITOR WELL NO. MW-2

WELL SCHEMATIC
Casing Elevation: 253.63
Casing Stickup: 3.5

DEPTH IN FEET	Blow-Count	Samples	Group Symbol	DESCRIPTION (Surface Elevation: 250.1)
0		CA	SM	DARK GRAY SILTY FINE SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, DAMP) (FILL)
	10	CA		
5				
	19			
10				
	86		SW	BROWN FINE TO COARSE SAND WITH A TRACE OF GRAVEL (VERY DENSE, DAMP)
15				
	75			
20				
	68	CA		GRADES TO GRAY IN COLOR MODERATE HYDROCARBON ODOR AND VISIBLE CONTAMINATION AT 23.5 FEET
25			SP	GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT (DENSE, MOIST TO WET)
	44			
30				
	45			
35				
	50/4"			
40				

NATIVE SOIL AND BENTONITE BACKFILL

2-INCH SCHEDULE 40 PVC PIPE

MEDIUM SILICA SAND BACKFILL

2-INCH SCHEDULE 40 PVC, 0.020-INCH SLOT WIDTH

WATER LEVEL ON 9/26/86

39.5 FEET BASE OF WELL

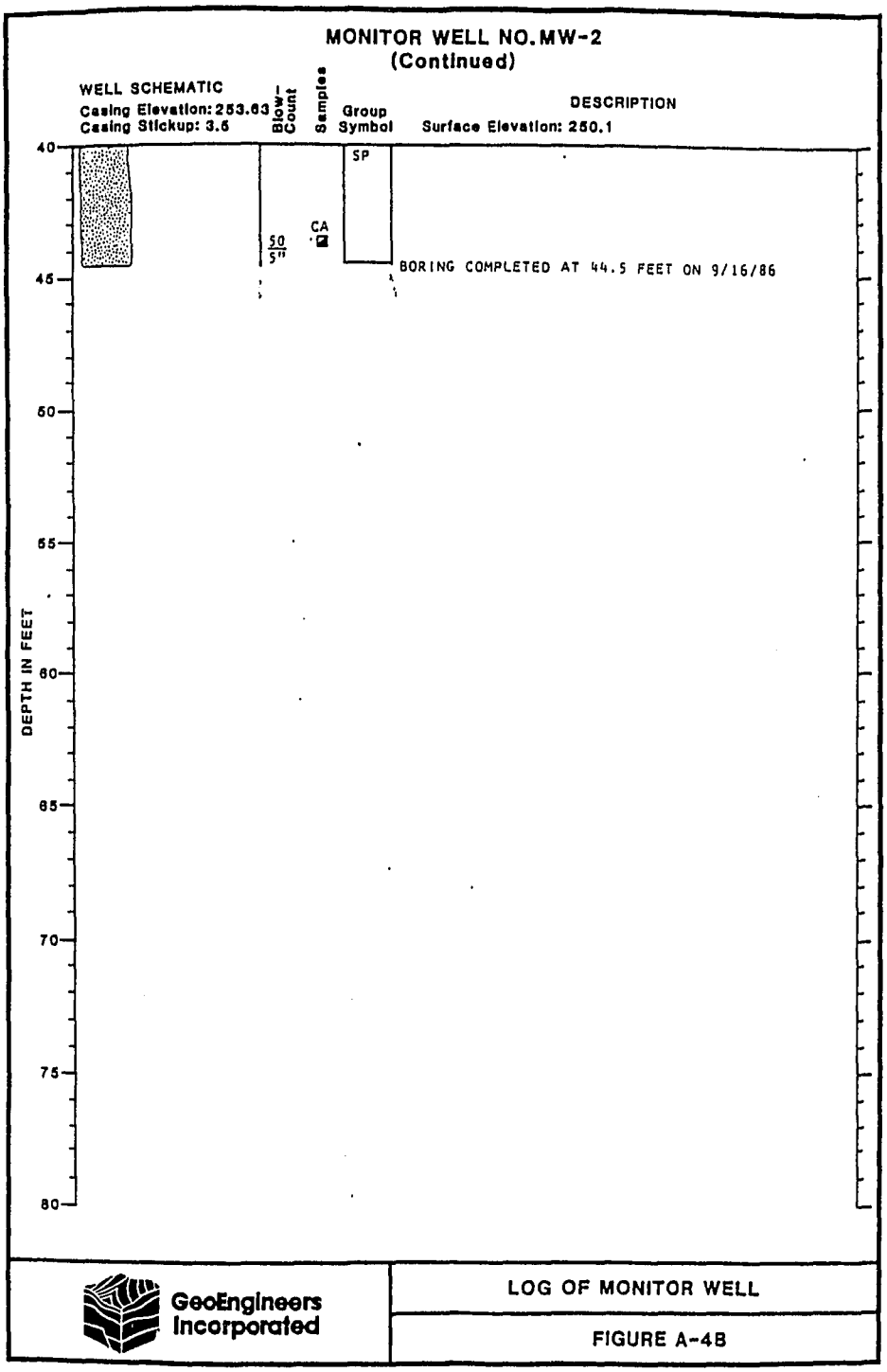
GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-4A

1059-01 JAM: DWP: EL 10-16-86

MONITOR WELL NO. MW-2
(Continued)



GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-4B

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES
DRILLER	KEVIN CROSS
DRILLING METHOD	HOLLOW STEM AUGER
DRILL BIT(S) SIZE:	4 1/4" I.D.
ISOLATION CASING	N.A. FROM TO FT.
BLANK CASING	2" SCHEDULE 40 PVC FROM 0.0 TO 17.0 FT.
PERFORATED CASING	2", 0.020"-SLOT SCH 40 PVC FROM 17.0 TO 42.0 FT.
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND FROM 14.0 TO 42.0 FT.
SEAL	1/4" BENTONITE PELLETS FROM 12.0 TO 14.0 FT.
GROUT	CEMENT/BENTONITE MIX FROM 0.0 TO 12.0 FT.

Boring/Well Name	NMW-8
Project Name	AMSTED
Project Number	916058.00
ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 03/09/1992	DATE COMPLETED 03/09/1992
INITIAL WATER DEPTH (FT) 27.0	
LOGGED BY SJR	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ■ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
								SM	**Silty SAND with gravel** black, mostly fine to coarse sand, some silt and fine gravel. Plant fragments
S	0.6	5 9 8 7	5	NMW-8A-4.0		4			
								GP	**Poorly graded GRAVEL** dark yellowish brown, mostly rounded flat fine gravel, some fine to medium sand, trace silt
S	1.6	16 26 26	10	NMW-8A-9.0		.1			
									increasing sand
S	1.7	8 24 33 32	15	NMW-8A-14.0		.5			
S	0.5	2 50	20	NMW-8A-19.0		.1			decreasing sand
S	0.8	11 33 50	25	NMW-8A-24.0		.1			increasing sand, moist, wet at 27 feet
S	0.4	50		NMW-8A-26.0		.6		SP	**Poorly graded SAND** olive gray, mostly medium sand, few fine sand
S	1.5	50		NMW-8A-27.0		.6			
			30						

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-8

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
			35						flowing sands into sampler
S	1.5	50		NMW-8A-34.0		1.6		SP	
S		50	40	NMW-8A-39.0		NA			
			45						
			50						
			55						
			60						
			65						
			70						

SHEET 2 OF 2

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED		
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES	DRILLER	KEVIN CROSS
DRILLING METHOD	HOLLOW STEM AUGER	DRILL BIT(S) SIZE	4 1/4" I.D.

		FROM	TO	FT.
ISOLATION CASING	N.A.			
BLANK CASING	4" SCHEDULE 40 PVC	-3.0	17.0	FT.
PERFORATED CASING	4", 0.020"-SLOT SCH 40 PVC	17.0	42.0	FT.
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND	14.0	39.0	FT.
SEAL	1/4" BENTONITE PELLETS	12.0	14.0	FT.
GROUT	CEMENT/BENTONITE MIX	0.0	12.0	FT.

Boring/Well Name NMW-9
Project Name AMSTED
Project Number 916058.00

ELEVATION AND DATUM	TOTAL DEPTH 45.0
DATE STARTED 03/10/1992	DATE COMPLETED 03/11/1992
INITIAL WATER DEPTH (FT) 28.0	
LOGGED BY SJR	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ☒ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
								GM	**Silty GRAVEL with sand** black, mostly fine gravel, some silt, little sand. Metallic fragments.
S	0.5	2 3 4 3	5	NMW-9A-4.0		1			
									Poorly graded GRAVEL with sand dark yellowish brown, mostly rounded fine gravel, little fine to medium sand
S	1.5	5 13 15 20	10	NMW-9A-9.0		.5			
S	1.8	18 38 47 42	15	NMW-9A-14.0		.5		GP	darker in color, increasing sand to coarse gravel
S	0.2	20 50	20	NMW-9A-19.0		1.4			moist
									strong petroleum odor, oily brown coating
S	0.5	50		NMW-9A-23.0		20			
S	0.5	40 50		NMW-9A-24.0		15			
S	0.5	50	25	NMW-9A-25.0		.5			**Poorly graded SAND** olive gray, mostly medium sand, some fine sand. Slight petroleum odor, slight sheen. Trace gravel
S	1.0	45 50		NMW-9A-26.0		10		SP	
S	1.5	42 50 50 50		NMW-9A-27.0	▽	1			wet at 28 feet, slight sheen on water
			30						

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-9

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	1.0	13 50	35	NMW-9A-34.0		9		SP	
S	1.7	35 50	40	NMW-9A-39.0		3.5			filter pack is natural caved material from 39 feet to bottom
S	1.8	4 20 27 32	45	NMW-9A-44.0		9.5			few silt
			50						
			55						
			60						
			65						
			70						

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES
DRILLER	KEVIN CROSS
DRILLING METHOD	HOLLOW STEM AUGER
DRILL BIT(S) SIZE	4 1/4" I.D.
ISOLATION CASING	N.A. FROM TO FT.
BLANK CASING	2" SCHEDULE 40 PVC FROM 0.0 TO 16.0 FT.
PERFORATED CASING	2", 0.020"-SLOT SCH 40 PVC FROM 16.0 TO 42.0 FT.
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND FROM 13.0 TO 41.0 FT.
SEAL	1/4" BENTONITE PELLETS FROM 11.0 TO 13.0 FT.
GROUT	CEMENT/BENTONITE MIX FROM 0.0 TO 13.0 FT.

Boring/Well Name	NMW-10
Project Name	AMSTED
Project Number	916058.00
ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 03/11/1992	DATE COMPLETED 03/12/1992
INITIAL WATER DEPTH (FT) 25.5	
LOGGED BY SJR	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ■ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN)	DEPTH (FEET)	SAMPLE NO.	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
							GM	**Silty GRAVEL with sand** black, mostly angular gravel, little sand, little silt, trace scrap metal, slag
S	0.8	3 4 2 2	5	NMW-10A-4.0	2			
							GP	**Poorly graded GRAVEL with sand** dark yellowish brown, mostly rounded fine gravel, little medium sand, trace slag
S	1.5	13 25 24 28	10	NMW-10A-9.0	10			
								trace coarse gravel
S	1.5	11 24 25 29	15	NMW-10A-14.0	3			
								increasing sand
S	1.2	24 36 50	20	NMW-10A-19.0	5			
S	1.0	28 50		NMW-10A-22.0	4			mostly flat gravel, moist
S	0.6	11 50	25	NMW-10A-24.0	5			wet at 25.5 feet
S	1.0	28 50		NMW-10A-26.0	1		SP	**Poorly graded SAND** dark yellowish brown (salt and pepper coloration), mostly medium sand, little fine sand, trace fines
S	2.0	15 33 39 50		NMW-10A-27.0	10			
			30					

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-10

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST. (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	1.5	10 45 50	35	NMW-10A-34.0		.5		SP	
S		5 21 45 50	40	NMW-10A-39.0		9			
			45						
			50						
			55						
			60						
			65						
			70						

SHEET 2 OF 2

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED			
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES	DRILLER	KEVIN CROSS	
DRILLING METHOD	HOLLOW STEM AUGER	DRILL BIT(S) SIZE:	4 1/4" I.D.	
ISOLATION CASING	N.A.	FROM	TO	FT.
BLANK CASING	2" SCHEDULE 40 PVC	FROM -3.0	TO 17.0	FT.
PERFORATED CASING	2", 0.020"-SLOT SCH 40 PVC	FROM 17.0	TO 42.0	FT.
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND	FROM 14.0	TO 42.0	FT.
SEAL	1/4" BENTONITE PELLETS	FROM 12.0	TO 14.0	FT.
GROUT	CEMENT/BENTONITE MIX	FROM 0.0	TO 12.0	FT.

Boring/Well Name NMW-11
Project Name AMSTED
Project Number 916058.00

ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 03/13/1992	DATE COMPLETED 03/13/1992
INITIAL WATER DEPTH (FT) 26.5	
LOGGED BY OGL	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ▩ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
									Poorly graded SAND dark brown to black, contains debris including concrete, brick, and slag
S	0.5	3 5 2 3	5	NMW-11A-5.0		1		SP	
S	2.0	3 4 5 9	10	NMW-11A-10.0		.4			mostly medium to fine sand, light brown, few fines, moist
								GP/GM	**Poorly graded GRAVEL with silt and sand**
S	2.0	11 22 23 34	15	NMW-11A-15.0		.3			**Poorly graded SAND** light brown, mostly medium to fine sand, few fines, moist
S	0.5	9 45	20	NMW-11A-20.0		5		GW	**Well-graded GRAVEL with sand** light brown, mostly gravel, some sand, moist
S	1.5	9 19 25 25	25	NMW-11A-25.0	▽	1.5			**Poorly graded SAND** mostly medium to fine sand, few gravel, no sheen, wet
S	2.0	19 35 34 25		NMW-11A-27.0		8.2		SP	
			30						

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-11

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	1.5	2 9 30 38	35	NMW-11A-35.0		2.5		SP	
S	2.0	2 9 27 35	40	NMW-11A-40.0		9			
			45						
			50						
			55						
			60						
			65						
			70						

SHEET 2 OF 2

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED			
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES	DRILLER	KEVIN CROSS	
DRILLING METHOD	HOLLOW STEM AUGER	DRILL BIT(S) SIZE:	8" O.D.	
ISOLATION CASING	N.A.	FROM	TO	FT.
BLANK CASING	2" SCHEDULE 40 PVC	FROM -3.0	TO 17.0	FT.
PERFORATED CASING	2", 0.020"-SLOT SCH 40 PVC	FROM 17.0	TO 42.0	FT.
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND	FROM 14.0	TO 42.0	FT.
SEAL	1/4" BENTONITE PELLETS	FROM 12.0	TO 14.0	FT.
GROUT	CEMENT/BENTONITE MIX	FROM 0.0	TO 12.0	FT.

Boring/Well Name NMW-12

Project Name AMSTED

Project Number 916058.00

ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 03/12/1992	DATE COMPLETED 03/12/1992
INITIAL WATER DEPTH (FT) 27.0	
LOGGED BY SJR	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ▩ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	OVA	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
						SP/SM	**Poorly graded SAND with silt and gravel** fill material, orange to black, mostly fine to medium sand, some angular slag gravel, few silt
S	0.6	4 6 6 6	5	NMW-12A-5.0	1		
						SP	**Poorly graded SAND** yellowish brown to dark yellowish brown, mostly fine sand, some medium sand
S	1.8	2 4 6 6	10	NMW-12A-10.0	.5		
						GP	**Poorly graded GRAVEL with sand** dark yellowish brown, mostly rounded fine gravel, some medium sand
S	1.6	16 32 42 44	15	NMW-12A-15.0	5		
							few silt
S	0.8	4 45 50	20	NMW-12A-20.0	2		
						SP	**Poorly graded SAND** dark yellowish brown, mostly medium sand, few fine sand, trace silt, trace coarse gravel, moist at 24 feet
S	1.7	7 29 39 39		NMW-12A-23.0	2		
S	1.5	21 37 50	25	NMW-12A-25.0	5		
S	1.0	27 50		NMW-12A-27.0	3		wet at 27 feet, increasing fine sand
			30				

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-12

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
			35						
S	1.0	11 50		NMW-12A-35.0		5		SP	some fine sand, trace silt
			40						mostly medium to coarse sand, few fine sand
S	0.8	3 6 8 8		NMW-12A-40.0		.5			
			45						
			50						
			55						
			60						
			65						
			70						

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED		
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES	DRILLER	KEVIN CROSS
DRILLING METHOD	HOLLOW STEM AUGER	DRILL BIT(S) SIZE	8 1/4" I.D.
ISOLATION CASING	N.A.	FROM / TO	FT.
BLANK CASING	6" SCHEDULE 40 PVC	FROM -3.0 TO 17.0	FT.
PERFORATED CASING	6", 0.020"-SLOT SCH 40 PVC	FROM 17.0 TO 42.0	FT.
SIZE AND TYPE OF FILTER PACK	8-12 COLORADO SILICA SAND	FROM 13.0 TO 42.0	FT.
SEAL	3/4" BENTONITE CHIPS	FROM 11.0 TO 13.0	FT.
GROUT	CEMENT/BENTONITE MIX	FROM 0.0 TO 11.0	FT.

Boring/Well Name	NMW-13
Project Name	AMSTED
Project Number	916058.00
ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 03/16/1992	DATE COMPLETED 03/16/1992
INITIAL WATER DEPTH (FT) 27.0	
LOGGED BY OGL	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ■ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
								GP	**Poorly graded GRAVEL with sand** tank backfill material
			5						
S	1.0	1 2 2 2		NMW-13A-5.0		.5			**Poorly graded SAND with gravel** mostly sand, some gravel, dark brown to black
			10						
S		3 5 5 3		NMW-13A-10.0		.5			
			15					SP	Increasing gravel, dark brown, slight sheen,
S	1.5	5 24 30 31		NMW-13A-15.0		7.5			no odor
			20						gravel size increasing, heavy petroleum
S	1.0	8 33		NMW-13A-20.0		15			staining, black
			25						**Poorly graded SAND**
S		1 16 43 45		NMW-13A-25.0		30		SP	mostly medium to fine sand, stained
			30						
S		10 20 30 48		NMW-13A-29.5		400			

Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-13

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
			35						
S	0.7	5 9 33		NMW-13A-35.0		500		SP	
			40						
S		3 12 35		NMW-13A-40.0		10			
			45						
			50						
			55						
			60						
			65						
			70						

SHEET 2 OF 2

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION	AMSTED		
DRILLING COMPANY	LAYNE ENVIRONMENTAL SERVICES	DRILLER	KEVIN CROSS
DRILLING METHOD	HOLLOW STEM AUGER	DRILL BIT(S) SIZE:	4 1/4" I.D.

		FROM	TO	FT.
ISOLATION CASING	N.A.			
BLANK CASING	2" SCHEDULE 40 PVC	-3.0	17.0	
PERFORATED CASING	2", 0.020"-SLOT SCH 40 PVC	17.0	42.0	
SIZE AND TYPE OF FILTER PACK	10-20 COLORADO SILICA SAND	14.0	42.0	
SEAL	1/4" BENTONITE PELLETS	12.0	14.0	
GROUT	CEMENT/BENTONITE MIX	0.0	12.0	

Boring/Well Name NMW-14
Project Name AMSTED
Project Number 916058.00

ELEVATION AND DATUM	TOTAL DEPTH 42.0
DATE STARTED 04/15/1992	DATE COMPLETED 04/15/1992
INITIAL WATER DEPTH (FT) 28.0	
LOGGED BY SJR	
SAMPLING METHODS 2.5" I.D. SPLIT SPN.	WELL COMPLETION ☐ SURFACE HOUSING ■ STAND PIPE ____ FT.

SAMPLES TYPE	RECOVERY (FEET)	PENETRATION RESIST (BLOWS/6 IN.)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
									SILT black, mostly silt, few sand, metallic particles, fill material, moist
S	1.0	2 4 4 3	5	NMW-14A-4.0		<0.1		ML	wood fragments, woody odor
S	1.5	6 8 10 14	10	NMW-14A-9.0		1		SP	**Poorly graded SAND** yellowish brown, mostly fine sand, few medium sand, trace silt, moist
S	1.5	6 14 30 31	15	NMW-14A-14.0		.5		GW	**Well-graded GRAVEL** dark yellowish brown, mostly rounded fine gravel, some sand, few silt, moist, wood fragments, woody odor
S	1.5	6 36 36 36	20	NMW-14A-19.0		1			increasing sand, wood absent
S	1.6	8 24 30 35	25	NMW-14A-24.0		5		SP	**Poorly graded SAND** salt and pepper color, mostly medium sand, some fine sand, few silt, moist
									wet at 28 feet
S	0.8	18 50	30	NMW-14A-29.0		25			dark yellowish brown, mostly fine sand, some silt

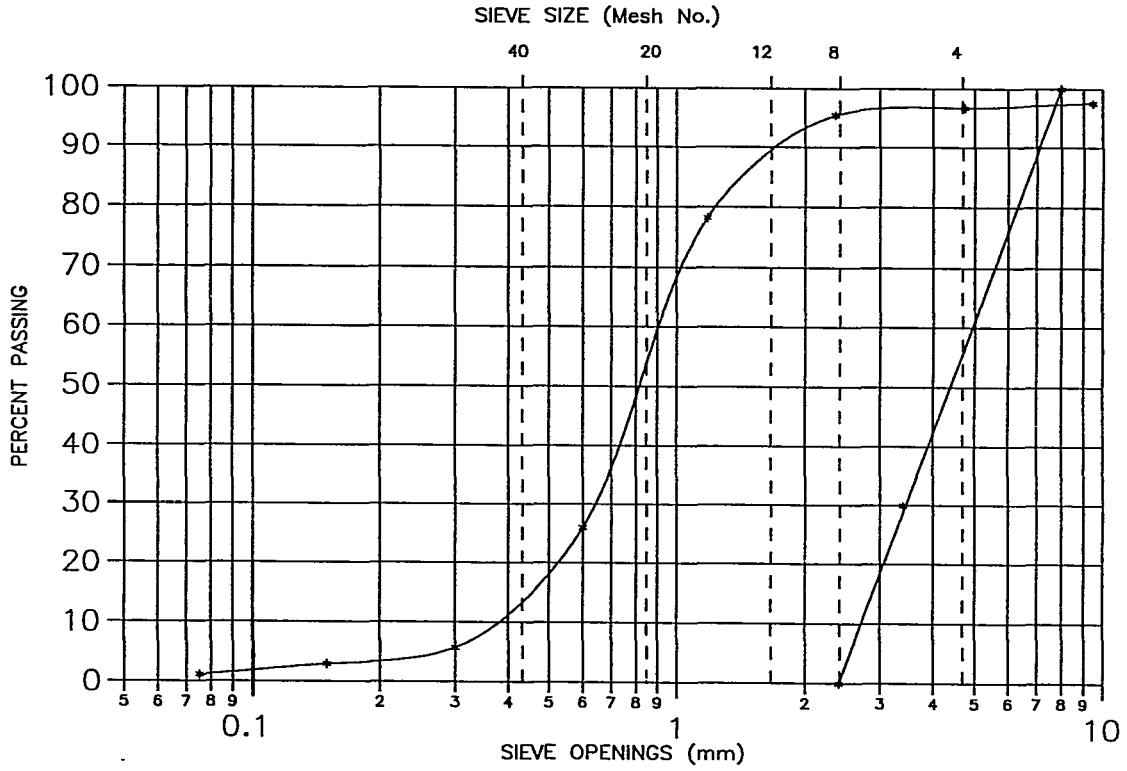
Boring & Well Construction Log — Kennedy/Jenks Consultants

Project Name AMSTED **Project Number** 916058.00 **Boring/Well Name** NMW-14

SAMPLES TYPE	SAMPLES RECOVERY (FEET)	SAMPLES PENETRATION RESIST (BLOWS/6 IN)	DEPTH (FEET)	SAMPLE NO.	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
S	1.0	18 50	35	NMW-14A-34.0		3		SP	mostly medium sand, some fine sand, trace silt
S	1.1	6 50	40	NMW-14A-39.0		38			mostly medium sand, few gravel, few coarse sand, few silt
			45						
			50						
			55						
			60						
			65						
			70						

SHEET 2 OF 2

NMW–8



D_{60} = 0.94
D_{30} = 0.64
D_{10} = 0.38
$Cu_S = D_{60}/D_{10} = 2.47$
$Cu_{(fp)}$ = 2.5
F_{30} = 5
$D_{30(fp)}$ = 3.2

Appendix D

Product Analytical Results

STF Number	Lab Number	Chloromethane (ug/kg)	Bromomethane (ug/kg)	Vinyl Chloride (ug/kg)	Chloroethane (ug/kg)	Methylene Chloride (ug/kg)	Acetone (ug/kg)	Carbon Disulfide (ug/kg)	1,1-Dichloroethene (ug/kg)
1774 PP0000000000.000	9201-140-1	U 500.0000 R	U 500.0000 R	U 50.0000 R	U 50.0000 R	B 2000.0000 R	JB 300.0000 R	U 50.0000 R	U 50.0000 R
1774 PP0000000000.000	9201-140-1DP	U 500.0000	U 500.0000	U 50.0000	U 50.0000	B 790.0000 UJ	JB 340.0000 UJ	U 50.0000	U 50.0000

DATA VALIDATION
DATE RECEIVED
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CHECKED BY RM DATE 6/15/92

Analytical data for VOLATILES for file AMOILDV.DBF 06/15/92 23:00:00 5,016 bytes
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STF Number	Lab Number	1,1-Dichloroethane (ug/kg)	1,2-Dichloroethene (total) (ug/kg)	Chloroform (ug/kg)	1,2-Dichloroethane (ug/kg)	2-Butanone (ug/kg)	1,1,1-Trichloroethane (ug/kg)	Carbon Tetrachloride (ug/kg)	Bromodichloromethane (ug/kg)
1774 PP0000000000.000	9201-140-1	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 500.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R
1774 PP0000000000.000	9201-140-1DP	U 50.0000	U 50.0000	U 50.0000	U 50.0000	U 500.0000 R	U 50.0000	U 50.0000	U 50.0000

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STF Number	Lab Number	1,2-Dichloropropane (ug/kg)	cis-1,3-Dichloropropene (ug/kg)	Trichloroethene (ug/kg)	Dibromochloromethane (ug/kg)	1,1,2-Trichloroethane (ug/kg)	Benzene (ug/kg)	trans-1,3-Dichloropropene (ug/kg)	Bromoform (ug/kg)
1774 FF0000000000.000	9201-140-1	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 250.0000 R
1774 FF0000000000.000	9201-140-1DP	U 50.0000	U 50.0000	U 50.0000	U 50.0000	U 50.0000	50.0000	U 50.0000	U 250.0000

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STF Number	Lab Number	4-Methyl-2-pentanone (ug/kg)	2-Hexanone (ug/kg)	Tetrachloroethene (ug/kg)	Toluene (ug/kg)	1,1,2,2-Tetrachloroethane (ug/kg)	Chlorobenzene (ug/kg)	Ethyl Benzene (ug/kg)	Styrene (ug/kg)
1774 PP0000000000.000	9201-140-1	U 500.0000 R	U 500.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	U 50.0000 R	810.0000 R	U 50.0000 R
1774 PP0000000000.000	9201-140-1DP	U 500.0000	U 500.0000	U 50.0000	U 50.0000	U 50.0000	U 50.0000	1800.0000	U 50.0000

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STF Number	Lab Number	Xylenes (total) (ug/kg)
1774 PF0000000000.000	9201-140-1	420.0000 E
1774 PF0000000000.000	9201-140-1DP	920.0000

06/15/92 Analytical data for VOLATILES for file AMOILDV.DBF 06/15/92 23:00:00 5,016 bytes Page 5

STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1774PP000000000.000	9201-140-1	Cyclohexane, 1,3-dimethyl-,	JN	1200.00	
		Cyclohexane, 1,2-dimethyl-,	JN	850.00	
		Cyclohexane, 1,1,3-trimethyl	JN	5000.00	
		Cyclohexane, 1,3,5-trimethyl	JN	850.00	
		Cyclohexane, 1,3-dimethyl-,	JN	1350.00	
		UNKNOWN	JN	1800.00	
		UNKNOWN	JN	1400.00	
		Benzene, propyl-	JN	2050.00	
		UNKNOWN	JN	1200.00	
		Benzene, 1-ethyl-2-methyl-	JN	1100.00	
1774PP000000000.000	9201-140-1DP	Cyclohexane, methyl-	JN	1750.00	
		Cyclohexane, 1,2-dimethyl-,	JN	3100.00	
		Cyclohexane, 1,1,3-trimethyl	JN	8500.00	
		Cyclohexane, 1,2,4-trimethyl	JN	1750.00	
		Cyclopentane, (2-methylbutyl	JN	1700.00	
		Cyclohexane, 1,1-dimethyl-	JN	2950.00	
		UNKNOWN	JN	4100.00	
		Pentalene, octahydro-2-methy	JN	3600.00	
		Benzene, propyl-	JN	4500.00	
		Benzene, 1-ethyl-2-methyl-	JN	2550.00	

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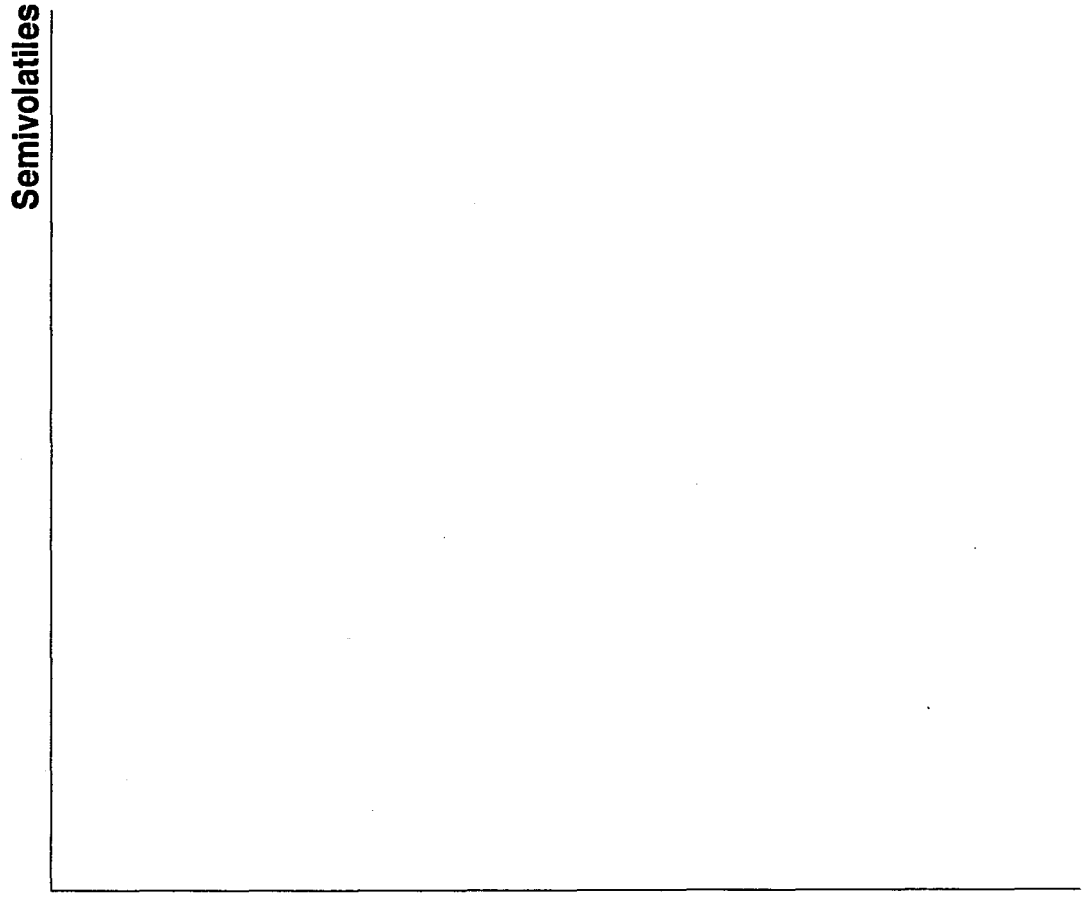
06/15/92 Page 1



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Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes

06/15/92

STF Number	Lab Number	Phenol (ug/kg)	bis(2-Chloro-ethyl) ether (ug/kg)	2-Chlorophenol (ug/kg)	1,3-Dichloro-benzene (ug/kg)	1,4-Dichloro-benzene (ug/kg)	1,2-Dichloro-benzene (ug/kg)	2-Methylphenol (ug/kg)	2,2'-oxybis (1-Chloropropane) (ug/kg)
1774 PF#########.###	9201-140-1	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000
1774 PF#########.###	9201-140-1RE	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000
1774 PF#########.###	9201-140-1A	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R
1774 PF#########.###	9201-140-1AR	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000

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STP Number	Lab Number	4-Methylphenol (ug/kg)	N-Nitroso-di-n-dipropylamine (ug/kg)	Hexachloroethane (ug/kg)	Nitrobenzene (ug/kg)	Isophorone (ug/kg)	2-Nitrophenol (ug/kg)	2,4-Dimethylphenol (ug/kg)	bis(2-Chloro-ethoxy) methane (ug/kg)
1774 PP0000000000.000	9201-140-1	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000
1774 PP0000000000.000	9201-140-1ER	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000
1774 PP0000000000.000	9201-140-1A	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R
1774 PP0000000000.000	9201-140-1AR	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000

AMSTED

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STF Number	Lab Number	2,4-Dichlorophenol (ug/kg)	1,2,4-Trichloro-benzene (ug/kg)	Naphthalene (ug/kg)	4-Chloroaniline (ug/kg)	Hexachloro-butadiene (ug/kg)	4-Chloro-3-methylphenol (ug/kg)	2-Methyl-naphthalene (ug/kg)	Hexachlorocyclo-pentadiene (ug/kg)
1774 FP0000000000.000	9201-140-1	U 5000.0000	U 5000.0000	73000.0000 J4	U 5000.0000	U 5000.0000	U 5000.0000	260000.0000 J4	U 5000.0000
1774 FP0000000000.000	9201-140-1RE	U 5000.0000	U 5000.0000	83000.0000 J4	U 5000.0000	U 5000.0000	U 5000.0000	290000.0000 J4	U 5000.0000 UJ
1774 FP0000000000.000	9201-140-1A	U 20000.0000 R	U 20000.0000 R	96000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	350000.0000 R	U 20000.0000 R
1774 FP0000000000.000	9201-140-1AR	U 20000.0000	U 20000.0000	110000.0000	U 20000.0000	U 20000.0000	U 20000.0000	380000.0000	U 20000.0000

Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes

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STF Number	Lab Number	2,4,6-Trichloro-phenol (ug/kg)	2,4,5-Trichloro-phenol (ug/kg)	2-Chloro-naphthalene (ug/kg)	2-Nitroaniline (ug/kg)	Dimethylphthalate (ug/kg)	Acenaphthylene (ug/kg)	2,6-Dinitrotoluene (ug/kg)	3-Nitroaniline (ug/kg)
1774 PP000000000.000	9201-140-1	U 5000.0000	U 5000.0000	U 5000.0000	U 12500.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 12500.0000
1774 PP000000000.000	9201-140-1RE	U 5000.0000 UJ	U 12500.0000 UJ	U 5000.0000 UJ	U 12500.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 12500.0000 UJ
1774 PP000000000.000	9201-140-1A	U 20000.0000 R	U 50000.0000 R	U 20000.0000 R	U 50000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 50000.0000 R
1774 PP000000000.000	9201-140-1AR	U 20000.0000	U 50000.0000	U 20000.0000	U 50000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 50000.0000

Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes
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STF Number	Lab Number	Acenaphthene (ug/kg)	2,4-Dinitrophenol (ug/kg)	4-Nitrophenol (ug/kg)	Dibenzofuran (ug/kg)	2,4-Dinitrotoluene (ug/kg)	Diethylphthalate (ug/kg)	4-Chlorophenyl-phenylether (ug/kg)	Fluorene (ug/kg)
1774 PP######0000.000	9201-140-1	U 5000.0000	U 12500.0000	U 12500.0000	U 5000.0000	U 5000.0000	U 5000.0000	U 5000.0000	180000.0000 J4
1774 PP######0000.000	9201-140-1RE	44000.0000 J4	U 12500.0000 UJ	U 12500.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	110000.0000 J4
1774 PP######0000.000	9201-140-1A	U 20000.0000 R	U 50000.0000 R	U 50000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	110000.0000 R
1774 PP######0000.000	9201-140-1AR	U 20000.0000	U 50000.0000	U 50000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	140000.0000

06/15/92 Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes Page 5

STF Number	Lab Number	4-Nitroaniline (ug/kg)	4,6-Dinitro-2-methylphenol (ug/kg)	N-nitrosodiphenylamine (ug/kg)	4-Bromophenyl-phenylether (ug/kg)	Hexachlorobenzene (ug/kg)	Pentachlorophenol (ug/kg)	Phenanthrene (ug/kg)	Anthracene (ug/kg)
1774 PP0000000000.000	9201-140-1	U 12500.0000	U 12500.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	180000.0000 J4	U 5000.0000 UJ
1774 PP0000000000.000	9201-140-1RE	U 12500.0000 UJ	U 12500.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 12500.0000 UJ	200000.0000 J4	U 5000.0000 UJ
1774 PP0000000000.000	9201-140-1A	U 50000.0000 R	U 50000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 50000.0000 R	170000.0000 R	U 20000.0000 R
1774 PP0000000000.000	9201-140-1AR	U 50000.0000	U 50000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 50000.0000	200000.0000	U 20000.0000

06/15/92 Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes Page 6

STF Number	Lab Number	Carbazole (ug/kg)	Di-n-butyl-phthalate (ug/kg)	Fluoranthene (ug/kg)	Pyrene (ug/kg)	Butylbenzyl-phthalate (ug/kg)	3,3'-Dichloro-benzidine (ug/kg)	Benzo(a)anthracene (ug/kg)	Chrysene (ug/kg)
1774 PP000000000.000	9201-140-1	U 5000.0000 UJ	U 5000.0000 UJ	25000.0000 J4	66000.0000 J4	U 5000.0000 UJ	U 5000.0000 UJ	23000.0000 J4	73000.0000 J4
1774 PP000000000.000	9201-140-1RE	32000.0000 J4	U 5000.0000 UJ	32000.0000 J4	78000.0000 J4	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	77000.0000 J4
1774 PP000000000.000	9201-140-1A	U 20000.0000 R	U 20000.0000 R	35000.0000 R	69000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	59000.0000 R
1774 PP000000000.000	9201-140-1AR	U 20000.0000	U 20000.0000	35000.0000	82000.0000	U 20000.0000	U 20000.0000	U 20000.0000	62000.0000

STF	Number	Lab Number	bis(2-Ethylhexyl) phthalate (ug/kg)	Di-n-octyl-phthalate (ug/kg)	Benzo(b)-fluoranthene (ug/kg)	Benzo(k)-fluoranthene (ug/kg)	Benzo(a)pyrene (ug/kg)	Indeno(1,2,3-cd)-pyrene (ug/kg)	Dibenzo(a,h)-anthracene (ug/kg)	Benzo(g,h,i)-perylene (ug/kg)
1774	FP000000000.000	9201-140-1	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ
1774	FP000000000.000	9201-140-1ER	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ	U 5000.0000 UJ
1774	FP000000000.000	9201-140-1A	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R	U 20000.0000 R
1774	FP000000000.000	9201-140-1AR	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000	U 20000.0000

Analytical data for SEMIVOLATILES for file AMOILDSV.DBF 06/15/92 23:00:00 11,250 bytes
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06/15/92 Analytical data for TICS FOR SEMIVOLATILES for file AMOILDST.DBF 06/15/92 23:00:00 7,837 bytes

STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1774PP000000000.000	9201-140-1	Unknown	JN	120000.00	
		Nonane, 2,6-dimethyl-	JN	140000.00	
		Naphthalene, decahydro-, tra	JN	240000.00	
		Unknown	JN	220000.00	
		CYCLOHEXANE, 1-METHYL-3-PROP	JN	76000.00	
		Nonane, 4,5-dimethyl-	JN	76000.00	
		CYCLOHEXANONE, 5-METHYL-2-(1	JN	144000.00	
		Undecane, 6-methyl-	JN	96000.00	
		1H-Indene, 2,3-dihydro-1,2-d	JN	150000.00	
		Unknown	JN	110000.00	
		Unknown	JN	80000.00	
		Undecane, 3,6-dimethyl-	JN	260000.00	
		Cyclopentane, 1-pentyl-2-pro	JN	164000.00	
		Unknown	JN	280000.00	
		Octane, 2,3,7-trimethyl-	JN	400000.00	
		NAPHTHALENE, 1-METHYL-	JN	80000.00	
		1,1'-Bicyclohexyl, 2-methyl-	JN	100000.00	
		Dodecane, 2,7,10-trimethyl-	JN	184000.00	
		Hexadecane	JN	70000.00	
		Tridecane, 5-propyl-	JN	124000.00	
1774PP000000000.000	9201-140-1A	1H-Indene, 2,3-dihydro-1,2-d	JN	280000.00	
		Unknown	JN	220000.00	
		Cyclohexane, (4-methylpentyl	JN	240000.00	
		Unknown	JN	300000.00	
		Cyclohexane, 2,4-diethyl-1-m	JN	260000.00	
		Octane, 2,3,7-trimethyl-	JN	520000.00	
		Cyclopentane, 2-ethyl-1,1-di	JN	280000.00	
		Unknown	JN	240000.00	
		Unknown	JN	440000.00	
		Dodecane, 2,7,10-trimethyl-	JN	680000.00	
		Naphthalene, 1,3-dimethyl-	JN	460000.00	
		Naphthalene, 1,7-dimethyl-	JN	660000.00	
		TRIDECANE, 6-PROPYL-	JN	1000000.00	
		Unknown	JN	440000.00	
		Naphthalene, 1,4,6-trimethyl	JN	340000.00	
		Docosane, 7-hexyl-	JN	380000.00	
		Naphthalene, 1,4,6-trimethyl	JN	480000.00	
		DODECANE, 2-METHYL-8-PROPYL-	JN	3400000.00	
		DOCOSANE	JN	1180000.00	
		Unknown	JN	420000.00	

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06/15/92 Analytical data for TICS FOR SEMIVOLATILES for file AMOILDST.DBF 06/15/92 23:00:00 7,837 bytes

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1774PP000000000.000	9201-140-1AR	1H-Indene, 2,3-dihydro-1,6-d	JN	260000.00	
		Cyclopentane, 1-methyl-2-(2-	JN	240000.00	
		Unknown	JN	300000.00	
		Cyclohexane, 1,2-diethyl-3-m	JN	320000.00	
		Octane, 2,3,7-trimethyl-	JN	500000.00	
		CYCLOPENTANE, 1-BUTYL-2-PENT	JN	260000.00	
		Unknown	JN	220000.00	
		Unknown	JN	460000.00	
		Unknown	JN	500000.00	
		Naphthalene, 1,7-dimethyl-	JN	540000.00	
		Naphthalene, 1,8-dimethyl-	JN	780000.00	
		Naphthalene, 1,2-dimethyl-	JN	720000.00	
		Dodecane, 2,7,10-trimethyl-	JN	1300000.00	
		Unknown	JN	700000.00	
		Eicosane, 7-hexyl-	JN	440000.00	
		Naphthalene, 1,6,7-trimethyl	JN	1020000.00	
		1H,3H-Thieno[3,4-c]thiophene	JN	420000.00	
		Unknown	JN	740000.00	
		Octadecane, 2,6-dimethyl-	JN	3800000.00	
		Docosane	JN	1340000.00	

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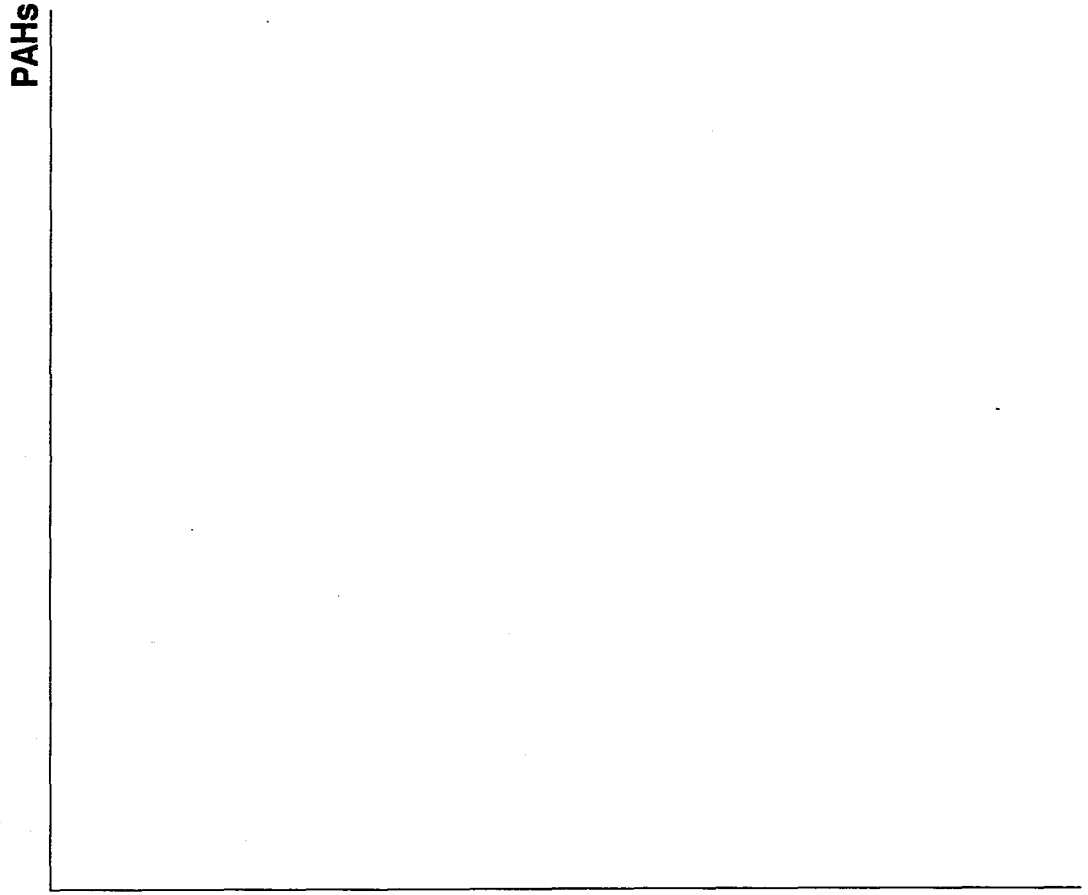

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Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMOILDP.DBF 06/15/92 23:00:00 2,940 bytes

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STF Number	Lab Number	Naphthalene (mg/kg)	Acenaphthylene (mg/kg)	Acenaphthene (mg/kg)	Fluorene (mg/kg)	Phenanthrene (mg/kg)	Anthracene (mg/kg)	Fluoranthene (mg/kg)	Pyrene (mg/kg)
1774 FP0000000000.000	9201-140-1	U 240.0000	U 410.0000	U 240.0000	66.0000	120.0000	U 24.0000	240.0000	35.0000
1774 FP0000000000.000	9201-140-1DP	U 240.0000	U 410.0000	U 240.0000	69.0000	120.0000	U 24.0000	330.0000	35.0000

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Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMOILDP.DBF 06/15/92 23:00:00 2,940 bytes

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STF Number	Lab Number	Benzo(a)anthracene (mg/kg)	Chrysene (mg/kg)	Benzo(b)-fluoranthene (mg/kg)	Benzo(k)-fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Indeno(1,2,3-cd)-pyrene (mg/kg)	Dibenzo(a,h)-anthracene (mg/kg)	Benzo(g,h,i)-perylene (mg/kg)
1774 FP8888888888.888	9201-140-1	U 24.0000	U 24.0000	U 24.0000	U 24.0000	U 24.0000	U 24.0000	U 48.0000	U 48.0000
1774 FP8888888888.888	9201-140-1DP	U 24.0000	U 24.0000	U 24.0000	U 24.0000	U 48.0000	U 24.0000	U 48.0000	U 48.0000

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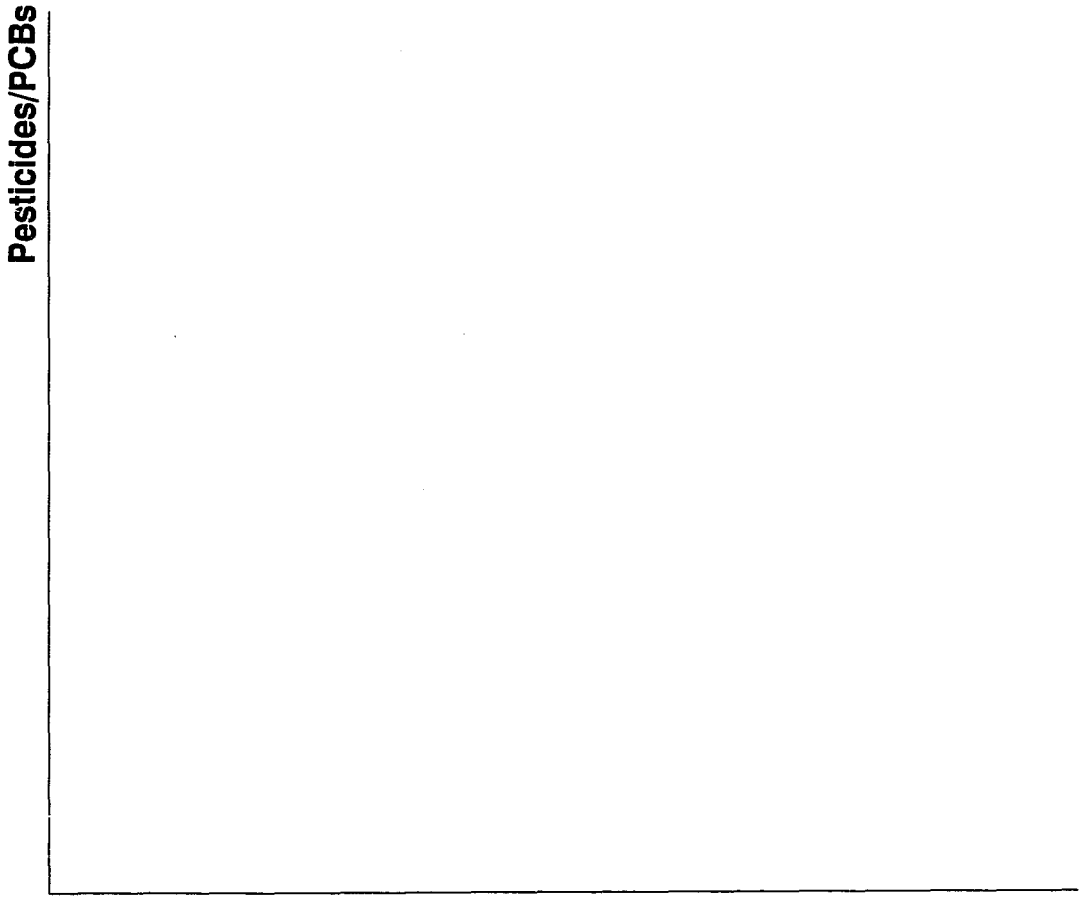

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06/15/92 Analytical data for PESTICIDES/PCB for file AMOILDPT.DBF 06/15/92 23:00:00 4,380 bytes Page 1

STF Number	Lab Number	alpha-BHC (ug/kg)	beta-BHC (ug/kg)	delta-BHC (ug/kg)	gamma-BHC (Lindane) (ug/kg)	Heptachlor (ug/kg)	Aldrin (ug/kg)	Heptachlor epoxide (ug/kg)	Endosulfan I (ug/kg)
1774 PP0000000000.000	9201-140-1	U 40.0000	U 40.0000	U 40.0000	U 40.0000 UJ	U 40.0000	U 40.0000 UJ	U 40.0000	U 40.0000
1774 PP0000000000.000	9201-140-1DP	U 40.0000	U 40.0000	U 40.0000	U 40.0000	U 40.0000	U 40.0000	U 40.0000	U 40.0000

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06/15/92 Analytical data for PESTICIDES/PCB for file AMOILDPT.DBF 06/15/92 23:00:00 4,380 bytes Page 1

STF Number	Lab Number	Dieldrin (ug/kg)	4,4'-DDE (ug/kg)	Endrin (ug/kg)	Endosulfan II (ug/kg)	4,4'-DDD (ug/kg)	Endosulfan sulfate (ug/kg)	4,4'-DDT (ug/kg)	Methoxychlor (ug/kg)
1774 FP0000000000.000	9201-140-1	U 96.0000	U 96.0000	U 96.0000 UJ	U 96.0000	U 96.0000	U 96.0000	U 96.0000	U 480.0000
1774 FP0000000000.000	9201-140-1DP	U 96.0000	U 96.0000	U 96.0000	U 96.0000	U 96.0000	U 96.0000	U 96.0000	U 480.0000

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Analytical data for PESTICIDES/PCB for file AMOILDPT.DBF 06/15/92 23:00:00 4,380 bytes

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STF Number	Lab Number	Endrin ketone (ug/kg)	alpha-Chlordane (ug/kg)	gamma-Chlordane (ug/kg)	Toxaphene (ug/kg)	Aroclor-1016 (ug/kg)	Aroclor-1221 (ug/kg)	Aroclor-1232 (ug/kg)	Aroclor-1242 (ug/kg)
1774 PP000000000.000	9201-140-1	U 96.0000	U 490.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000
1774 PP000000000.000	9201-140-1DP	U 96.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000

Analytical data for PESTICIDES/PCB for file AMOILDPT.DBF 06/15/92 23:00:00 4,380 bytes

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STF Number	Lab Number	Aroclor-1248 (ug/kg)	Aroclor-1254 (ug/kg)	Aroclor-1260 (ug/kg)
1774 FP0000000000.000	9201-140-1	U 480.0000	U 960.0000	U 960.0000
1774 FP0000000000.000	9201-140-1DP	U 480.0000	U 960.0000	U 960.0000

Analytical data for PESTICIDES/PCB for file AMOILDPT.DBF 06/15/92 23:00:00 4,380 bytes
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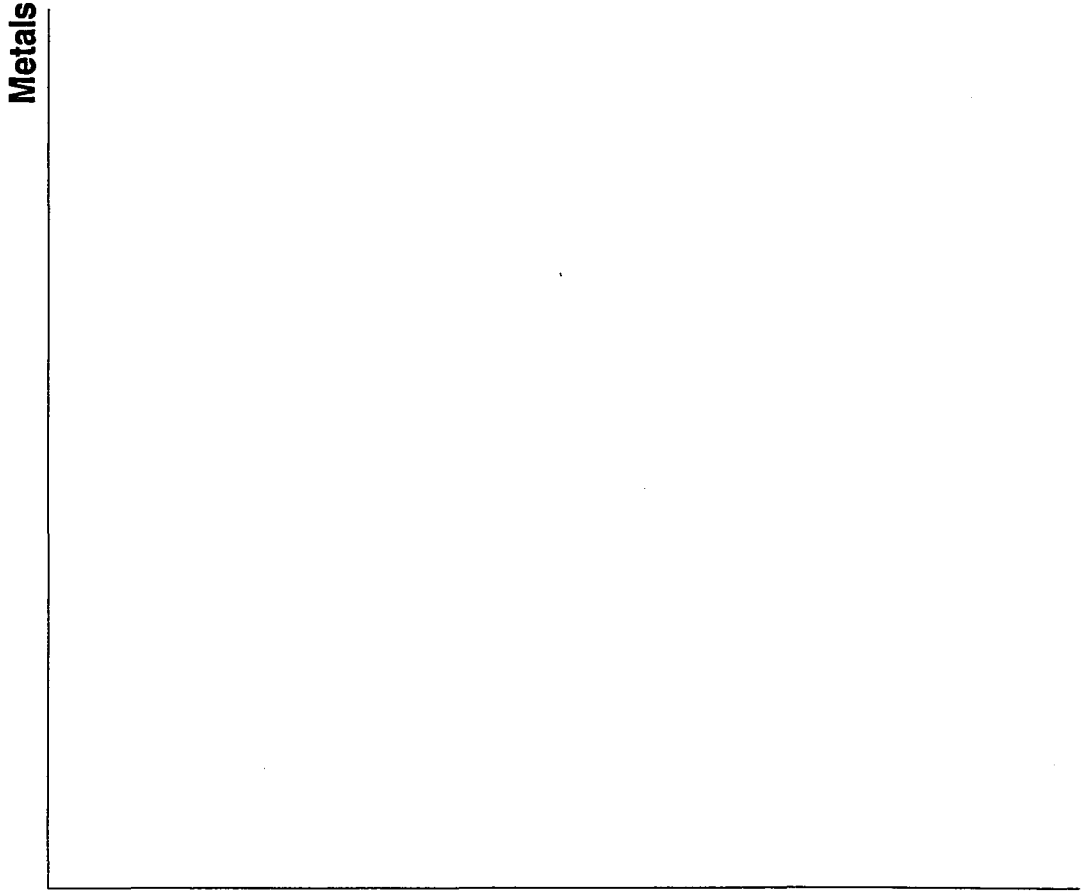

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Analytical data for METALS for file AMOILDM.DBF 06/15/92 23:00:00 8,317 bytes

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STP Number	Lab Number		Aluminum (mg/kg)		Antimony (mg/kg)		Arsenic (mg/kg)		Barium (mg/kg)		Beryllium (mg/kg)		Cadmium (mg/kg)		Calcium (mg/kg)		Chromium +3 (mg/kg)
1774 PP000000000.000	S20825	B	26.3000 UJ	U	6.6000	B SN	0.7900 R	B	0.2000 UJ	U	0.2000	U	0.6000	B	24.9000		0.0000
1774 PP000000000.000	S20825D	B	19.2000 UJ	U	6.6000	B	0.9000 R	U	0.2000	U	0.2000	U	0.6000	B	7.3000		0.0000

Analytical data for METALS for file AMOILDM.DBF 06/15/92 23:00:00 8,317 bytes

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06/15/92 Analytical data for METALS for file AMOILDM.DBF 06/15/92 23:00:00 8,317 bytes Page 2

STF Number	Lab Number	Chromium +6 (mg/kg)		Total Chromium (mg/kg)		Cobalt (mg/kg)		Copper (mg/kg)		Iron (mg/kg)		Lead (mg/kg)		Magnesium (mg/kg)		Manganese (mg/kg)	
1774 PP00000000.000	S20825	0.0000	U	1.0000	U	1.0000		6.5000	B	19.5000	UJ	0.4600	J4	15.1000	UJ	0.9800	
1774 PP00000000.000	S20825D	0.0000	U	1.0000	U	1.0000		6.0000	B	15.6000	UJ	0.5200	J4	11.0000	U	0.3700	

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STF Number	Lab Number		Mercury (mg/kg)		Nickel (mg/kg)		Potassium (mg/kg)		Selenium (mg/kg)		Silver (mg/kg)		Sodium (mg/kg)		Thallium (mg/kg)		Vanadium (mg/kg)
1774 PP0000000000.000	S20B25	U	0.1000		17.8000	U	173.0000	B N	0.2200 J4	U	1.2000	B	23.5000 UJ	U	0.4000 UJ		19.2000
1774 PP0000000000.000	S20B25D	U	0.1000		16.5000	U	173.0000	U	0.2000 UJ	U	1.2000	U	4.4000	U	0.4000 UJ		22.3000

STF Number	Lab Number		Zinc (mg/kg)	Boron (mg/kg)	Hardness SM 2340B (mg/kg)
1774 PP0000000000.000	S20825	B	0.4606 UJ	0.0000	0.0000
1774 PP0000000000.000	S20825D	B	0.7466 UJ	0.0000	0.0000

Analytical data for METALS for file AMOILDM.DBF 06/15/92 23:00:00 8,317 bytes
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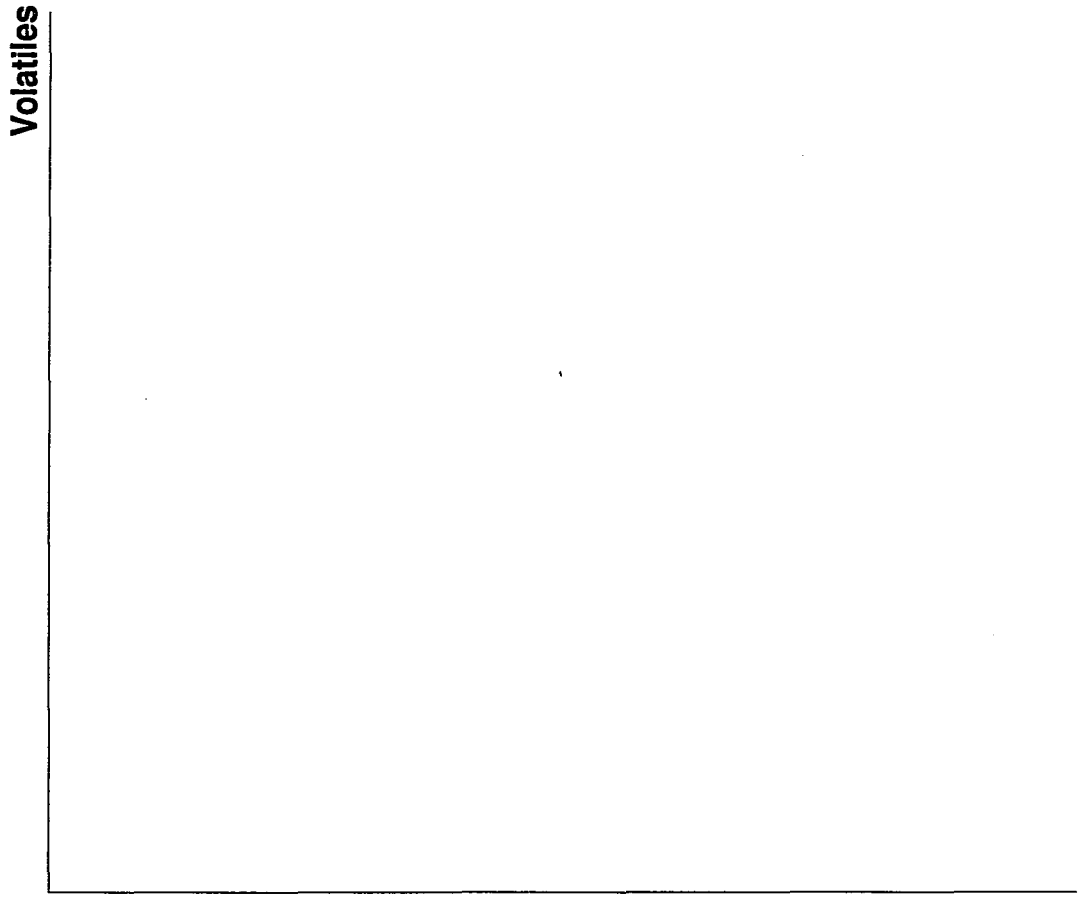
Appendix E

Soil Analytical Results



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06/11/92 Analytical data for VOLATILES for file AMSBV.DBF 06/12/92 23:00:00 6,290 bytes

STF Number	Lab Number	Chloromethane (ug/kg)	Bromomethane (ug/kg)	Vinyl Chloride (ug/kg)	Chloroethane (ug/kg)	Methylene Chloride (ug/kg)	Acetone (ug/kg)	Carbon Disulfide (ug/kg)	1,1-Dichloroethene (ug/kg)
1790 SB318000024.001	9203-112-1	U 19.0000	U 19.0000	U 19.0000	U 19.0000	B 160.0000 UJ	B 170.0000 UJ	U 19.0000	U 19.0000
1791 SB318000027.000	9203-205-1	U 12.0000	U 12.0000	U 12.0000	U 12.0000	B 16.0000 UJ	B 88.0000 UJ	U 12.0000	U 12.0000
1794 SB318000029.500	9203-205-2	U 11.0000	U 11.0000	U 11.0000	U 11.0000	B 16.0000 UJ	B 88.0000 UJ	U 11.0000	U 11.0000
1795 SB000000039.000	9204-167-1	U 11.0000	U 11.0000	U 11.0000	U 11.0000	JB 9.0000	B 26.0000	U 11.0000	U 11.0000

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STF Number	Lab Number	1,1-Dichloroethane (ug/kg)	1,2-Dichloroethene (total) (ug/kg)	Chloroform (ug/kg)	1,2-Dichloroethane (ug/kg)	2-Butanone (ug/kg)	1,1,1-Trichloroethane (ug/kg)	Carbon Tetrachloride (ug/kg)	Bromodichloromethane (ug/kg)
1790 SB31000024.001	9203-112-1	U 19.0000	U 19.0000	U 19.0000	U 19.0000	U 19.0000	U 19.0000	U 19.0000	U 19.0000
1791 SB31000027.000	9203-265-1	U 12.0000	U 12.0000	U 12.0000	U 12.0000	U 12.0000	U 12.0000	U 12.0000	U 12.0000
1794 SB31000029.500	9203-265-2	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1795 SB00000039.000	9204-167-1	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000

STF Number	Lab Number	1,2-Dichloropropane (ug/kg)	cis-1,3-Dichloropropene (ug/kg)	Trichloroethene (ug/kg)	Dibromochloromethane (ug/kg)	1,1,2-Trichloroethane (ug/kg)	Benzene (ug/kg)	trans-1,3-Dichloropropene (ug/kg)	Bromoform (ug/kg)
1790 SB31####024.###	9203-112-1	U 19.####	U 19.####	U 19.####	U 19.####	U 19.####	U 19.####	U 19.####	U 19.####
1791 SB31####027.###	9203-285-1	U 12.####	U 12.####	U 12.####	U 12.####	U 12.####	U 12.####	U 12.####	U 12.####
1794 SB31####029.###	9203-285-2	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####
1795 SB#########39.###	9204-167-1	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####	U 11.####

STF Number	Lab Number	4-Methyl-2-pentanone (ug/kg)	2-Hexanone (ug/kg)	Tetrachloroethene (ug/kg)	Toluene (ug/kg)	1,1,2,2-Tetrachloroethane (ug/kg)	Chlorobenzene (ug/kg)	Ethyl Benzene (ug/kg)	Styrene (ug/kg)
1790 SB318888824.881	9283-112-1	U 19.8888	U 19.8888	U 19.8888	J 6.8888	U 19.8888	U 19.8888	74.8888	U 19.8888
1791 SB318888827.888	9283-285-1	U 12.8888	U 12.8888	U 12.8888	U 12.8888	U 12.8888	U 12.8888	U 12.8888	U 12.8888
1794 SB318888829.588	9283-285-2	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888
1795 SB888888839.888	9284-167-1	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888	U 11.8888

STF Number	Lab Number		Xylenes (total) (ug/kg)
1790 SB310000026.001	9203-112-1		173.0000
1791 SB310000027.000	9203-265-1	U	12.0000
1794 SB310000029.500	9203-265-2	U	11.0000
1795 SB000000039.000	9204-167-1	U	11.0000

Analytical data for VOLATILES for file AMSBV.DBF 06/12/92 23:00:00 6,290 bytes
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06/11/92 Analytical data for TICS FOR VOLATILES for file AMSBVT.DBF 06/12/92 23:00:00 2,921 bytes Page 1

STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1790SB310000024.001	9203-112-1	Cyclohexane, 1,1,3-trimethyl	JN	270.00	
		Nonane, 3-methyl-	JN	370.00	
		Octane, 3,5-dimethyl-	JN	430.00	
		Undecane	JN	1200.00	
		Octane, 2,3,7-trimethyl-	JN	1100.00	
		UNKNOWN HYDROCARBON	JN	760.00	
		Octane, 2,5,6-trimethyl-	JN	620.00	

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06/11/92 Analytical data for TICS FOR VOLATILES for file AMSBVT.DBF 06/12/92 23:00:00 2,921 bytes Page 1

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Analytical data for SEMIVOLATILES for file AMSBSV.DBF 06/12/92 23:00:00 11,250 bytes

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STF	Number	Lab Number	Phenol (ug/kg)	bis(2-Chloro-ethyl) ether (ug/kg)	2-Chlorophenol (ug/kg)	1,3-Dichloro-benzene (ug/kg)	1,4-Dichloro-benzene (ug/kg)	1,2-Dichloro-benzene (ug/kg)	2-Methylphenol (ug/kg)	2,2'-oxybis (1-Chloropropane) (ug/kg)
1790	SB31#####24.001	9203-11Z-1	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000
1791	SB31#####27.000	9203-Z85-1	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000
1794	SB31#####29.500	9203-Z85-2	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000
1795	SB#########39.000	9204-167-1	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000

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Analytical data for SEMIVOLATILES for file AMSBSV.DBF 06/12/92 23:00:00 11,250 bytes

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STF Number	Lab Number	4-Methylphenol (ug/kg)	N-Nitroso-di-n-dipropylamine (ug/kg)	Hexachloroethane (ug/kg)	Nitrobenzene (ug/kg)	Isophorone (ug/kg)	2-Nitrophenol (ug/kg)	2,4-Dimethylphenol (ug/kg)	bis(2-Chloro-ethoxy) methane (ug/kg)
1790 SB310000024.001	9203-112-1	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000
1791 SB310000027.000	9203-205-1	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000
1794 SB310000029.500	9203-205-2	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000
1795 SB000000039.000	9204-167-1	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000

STF Number	Lab Number	2,4-Dichlorophenol (ug/kg)	1,2,4-Trichloro-benzene (ug/kg)	Naphthalene (ug/kg)	4-Chloroaniline (ug/kg)	Hexachloro-butadiene (ug/kg)	4-Chloro-3-methylphenol (ug/kg)	2-Methyl-naphthalene (ug/kg)	Hexachlorocyclo-pentadiene (ug/kg)
1790 SB310000024.001	9203-112-1	U 3700.0000	U 3700.0000	9300.0000	U 3700.0000	U 3700.0000	U 3700.0000	22000.0000	U 3700.0000
1791 SB310000027.000	9203-205-1	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000 UJ
1794 SB310000029.500	9203-205-2	U 2000.0000	U 2000.0000	J 1600.0000	U 2000.0000 UJ	U 2000.0000	U 2000.0000	3800.0000	U 2000.0000 UJ
1795 SB000000039.000	9204-167-1	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000

STF Number	Lab Number	2,4,6-Trichlorophenol (ug/kg)	2,4,5-Trichlorophenol (ug/kg)	2-Chloronaphthalene (ug/kg)	2-Nitroaniline (ug/kg)	Dimethylphthalate (ug/kg)	Acenaphthylene (ug/kg)	2,6-Dinitrotoluene (ug/kg)	3-Nitroaniline (ug/kg)
1790 SB3100000024.001	9203-112-1	U 3700.0000	U 9300.0000	U 3700.0000	U 9300.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 9300.0000
1791 SB3100000027.000	9203-205-1	U 400.0000	U 990.0000	U 400.0000	U 990.0000	U 400.0000	U 400.0000	U 400.0000	U 950.0000
1794 SB3100000029.500	9203-205-2	U 2000.0000	U 4900.0000	U 2000.0000	U 4900.0000 R	U 2000.0000	U 2000.0000	U 2000.0000	U 4900.0000
1795 SB0000000039.000	9204-167-1	U 370.0000	U 940.0000	U 370.0000	U 940.0000	U 370.0000	U 370.0000	U 370.0000	U 940.0000

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STF Number	Lab Number	Acenaphthene (ug/kg)	2,4-Dinitrophenol (ug/kg)	4-Nitrophenol (ug/kg)	Dibenzofuran (ug/kg)	2,4-Dinitrotoluene (ug/kg)	Diethylphthalate (ug/kg)	4-Chlorophenyl-phenylether (ug/kg)	Fluorene (ug/kg)
1790 SB310000024.001	9203-112-1	J 2400.0000	U 9300.0000	U 9300.0000	J 790.0000	U 3700.0000	U 3700.0000	U 3700.0000	3800.0000
1791 SB310000027.000	9203-205-1	U 480.0000	U 950.0000 UJ	U 950.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000	U 480.0000
1794 SB310000029.500	9203-205-2	U 2000.0000	U 4900.0000 R	U 4900.0000	J 160.0000	U 2000.0000	U 2000.0000	U 2000.0000	J 940.0000
1795 SB000000039.000	9204-167-1	U 370.0000	U 940.0000	U 940.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000

Analytical data for SEMIVOLATILES for file AMSBSV.DBF 06/12/92 23:00:00 11,250 bytes

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STP Number	Lab Number	4-Nitroaniline (ug/kg)	4,6-Dinitro-2-methylphenol (ug/kg)	N-nitrosodiphenylamine (ug/kg)	4-Bromophenyl-phenylether (ug/kg)	Hexachlorobenzene (ug/kg)	Pentachlorophenol (ug/kg)	Phenanthrene (ug/kg)	Anthracene (ug/kg)
1790 SB310000024.001	9203-112-1	U 9300.0000	U 9300.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 9300.0000	5100.0000	J 930.0000
1791 SB310000027.000	9203-205-1	U 990.0000	U 990.0000	U 400.0000	U 400.0000	U 400.0000	U 990.0000	U 400.0000	U 400.0000
1794 SB310000029.500	9203-205-2	U 4900.0000 UJ	U 4900.0000 UJ	U 2000.0000	U 2000.0000	U 2000.0000	U 4900.0000	J 1300.0000	J 140.0000
1795 SB000000039.000	9204-167-1	U 940.0000	U 940.0000	U 370.0000	U 370.0000	U 370.0000	U 940.0000	U 370.0000	U 370.0000

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STF Number	Lab Number	Carbazole (ug/kg)	Di-n-butyl-phthalate (ug/kg)	Fluoranthene (ug/kg)	Pyrene (ug/kg)	Butylbenzyl-phthalate (ug/kg)	3,3'-Dichloro-benzidine (ug/kg)	Benzo(a)anthracene (ug/kg)	Chrysene (ug/kg)
1790 SB31#####024.###	9203-112-1	U 3700.####	U 3700.####	J 310.####	J 1300.####	U 3700.####	U 3700.####	U 3700.####	J 1100.####
1791 SB31#####027.###	9203-205-1	U 400.####	BJ 160.#### UJ	U 400.####	U 400.####	U 400.####	U 400.####	U 400.####	U 400.####
1794 SB31#####029.###	9203-205-2	U 2000.####	U 2000.####	J 160.####	J 370.####	U 2000.####	U 2000.####	U 2000.####	J 330.####
1795 SB#########039.###	9204-167-1	U 370.####	B 1000.####	U 370.####	U 370.####	J 48.####	U 370.####	U 370.####	U 370.####

STF Number	Lab Number	bis(2-Ethylhexyl) phthalate (ug/kg)	Di-n-octyl-phthalate (ug/kg)	Benzo(b)-fluoranthene (ug/kg)	Benzo(k)-fluoranthene (ug/kg)	Benzo(a)pyrene (ug/kg)	Indeno(1,2,3-cd)-pyrene (ug/kg)	Dibenzo(a,h)-anthracene (ug/kg)	Benzo(g,h,i)-perylene (ug/kg)
1790 SB310000024.001	9203-112-1	BJ 1400.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000	U 3700.0000
1791 SB310000027.000	9203-205-1	BJ 130.0000 UJ	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000	U 400.0000
1794 SB310000029.500	9203-205-2	BJ 550.0000 UJ	U 2000.0000	U 2000.0000	J 160.0000	U 2000.0000	U 2000.0000	U 2000.0000	U 2000.0000
1795 SB000000039.000	9204-167-1	J 60.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000	U 370.0000

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Analytical data for TICS FOR SEMIVOLATILES for file AMSBST.DBF 06/12/92 23:00:00 9,190 bytes

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1790SB310000024.001	9203-112-1	1H-Indene, 2,3-dihydro-4-met	JN	5000.00	
		1H-Indene, 2,3-dihydro-1-met	JN	7800.00	
		1H-Indene, 2,3-dihydro-1,6-d	JN	13800.00	
		Dodecane, 6-methyl-	JN	10000.00	
		Unknown Hydrocarbon	JN	5200.00	
		Unknown Hydrocarbon	JN	9000.00	
		Octane, 2,3,7-trimethyl-	JN	15600.00	
		Unknown Aromatic	JN	4600.00	
		Benzene, 1-(1-methylethenyl)	JN	3800.00	
		Unknown Hydrocarbon	JN	8000.00	
		Dodecane, 2,7,10-trimethyl-	JN	8600.00	
		Naphthalene, 1-ethyl-	JN	11800.00	
		Naphthalene, 1,7-dimethyl-	JN	20000.00	
		Naphthalene, 1,2-dimethyl-	JN	36000.00	
		Naphthalene, 1,4-dimethyl-	JN	10800.00	
		Naphthalene, 1,4,6-trimethyl	JN	9400.00	
		Naphthalene, 1,6,7-trimethyl	JN	9000.00	
		Tetradecane, 2,6,10-trimethy	JN	9400.00	
		Naphthalene, 2,3,6-trimethyl	JN	16600.00	
		Dodecane, 2-methyl-8-propyl-	JN	8800.00	
1791SB310000027.000	9203-205-1	Unknown Hydrocarbon	JNB	1380.00	
		Unknown Hydrocarbon	JNB	320.00	
		2-Cyclohexen-1-one	JN	158.00	
		BENZALDEHYDE	JNB	120.00	
		Decane	JN	100.00	
		Cyclohexane, 1,2-dichloro-,	JN	80.00	
		Unknown Hydrocarbon	JNB	120.00	
1794SB310000029.500	9203-205-2	2,3-DIHYDRO-1-METHYLINDENE	JN	1080.00	
		1H-Indene, 2,3-dihydro-1,6-d	JN	880.00	
		UNDECANE, 2,6-DIMETHYL-	JN	1560.00	
		Cyclohexane, 2-butyl-1,1,3-t	JN	880.00	
		Unknown Hydrocarbon	JN	1480.00	
		1H-Indene, 2,3-dihydro-1,3-d	JN	1280.00	
		Octane, 2,3,7-trimethyl-	JN	3200.00	
		Naphthalene, 1-methyl-	JN	1560.00	
		Cyclohexane, hexyl-	JN	1960.00	
		Naphthalene, 1,7-dimethyl-	JN	3800.00	
		Naphthalene, 1,8-dimethyl-	JN	3800.00	
		SUBSTITUTED NAPHTHALENE	JN	2600.00	
		Dodecane, 2-methyl-8-propyl-	JN	1960.00	
		NAPHTHALENE, 1,6,7-TRIMETHYL	JN	2200.00	
		Tetradecane, 2,6,10-trimethy	JN	2600.00	
		NAPHTHALENE, 2,3,6-TRIMETHYL	JN	4200.00	
		Naphthalene, 1,2(or 2,3)-die	JN	2200.00	
		Tridecane, 5-propyl-	JN	3600.00	
		HEXADECANE, 2,6,10-TRIMETHYL	JN	8800.00	
		UNKNOWN ALKANE	JN	2400.00	

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/kg)	Validation
1795SB000000039.000	9204-167-1	Unknown Hydrocarbon	JN	200.00	
		Unknown	JNB	112.00	
		Unknown	JN	132.00	
		Unknown	JN	94.00	
		Unknown	JN	112.00	
		Unknown	JN	94.00	
		Unknown	JN	74.00	
		Unknown	JN	74.00	
		Unknown	JN	94.00	

Analytical data for TICS FOR SEMIVOLATILES for file AMSBST.DBF 06/12/92 23:00:00 9,190 bytes
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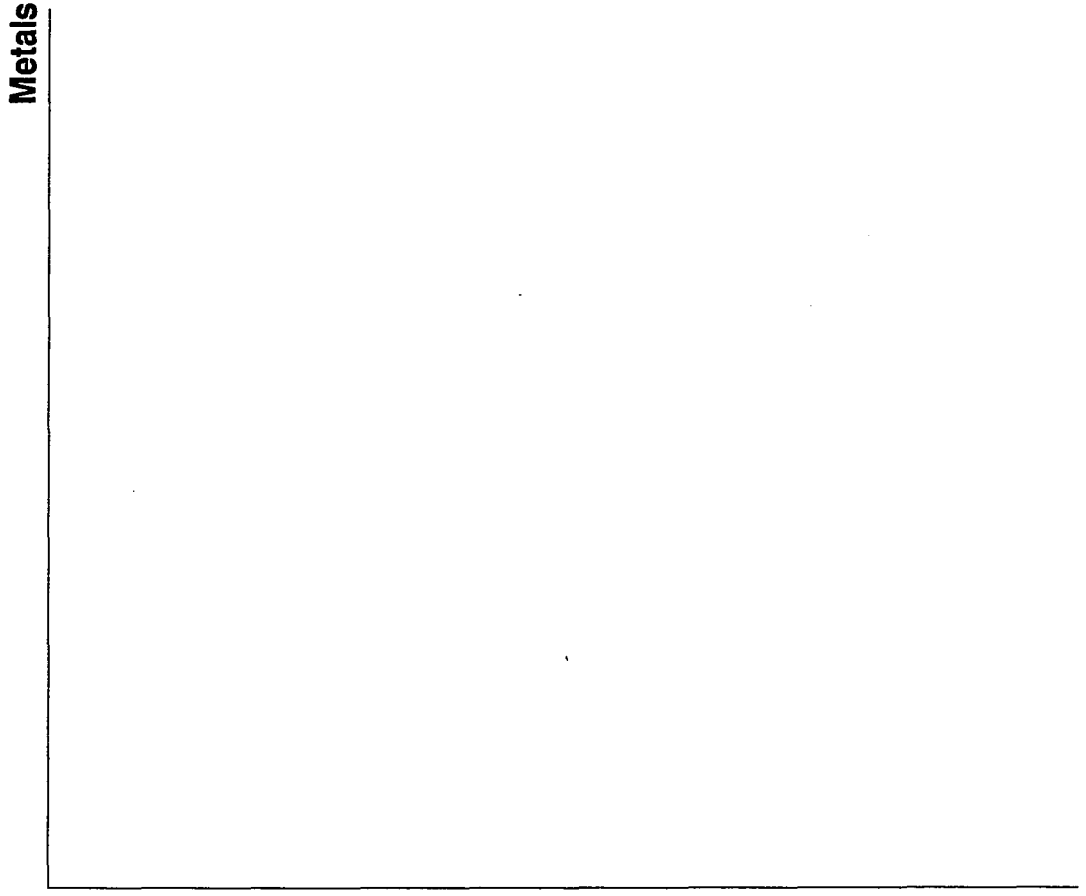

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06/11/92 Analytical data for METALS for file AMSBM.DBF 06/12/92 23:00:00 9,626 bytes

STP Number	Lab Number	Aluminum (mg/kg)		Antimony (mg/kg)		Arsenic (mg/kg)		Barium (mg/kg)		Beryllium (mg/kg)		Cadmium (mg/kg)		Calcium (mg/kg)	Chromium +3 (mg/kg)
1790 SB318000024.000	S22813	9640.0000	U	7.3000	SN	2.5000 J4	B	41.9000	B	0.2400	U	0.6600		4320.0000	0.0000
1791 SB318000027.000	S22814	18400.0000	U	7.5000	B N	2.2000 J4	B	48.7000	B	0.2700	U	0.7200		4460.0000	0.0000
1794 SB318000029.000	S22815	9740.0000	U	8.2000	B WN	1.6000 J4		57.7000	U	0.2500	U	0.7500		3770.0000	0.0000

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STF Number	Lab Number	Chromium +6 (mg/kg)		Total Chromium (mg/kg)		Cobalt (mg/kg)		Copper (mg/kg)	Iron (mg/kg)		Lead (mg/kg)		Magnesium (mg/kg)	Manganese (mg/kg)
1790 SB310000024.000	S22813	0.0000		21.3000	B	8.7000		13.3000	14500.0000	WH	1.2000	J4	5020.0000	261.0000
1791 SB310000027.000	S22814	0.0000		23.5000	B	8.4000		12.3000	15700.0000	WH	1.1000	J4	5430.0000	282.0000
1794 SB310000029.000	S22815	0.0000		20.0000	B	8.1000		20.9000	15000.0000	SH	3.0000	J4	5320.0000	237.0000

STF Number	Lab Number		Mercury (mg/kg)		Nickel (mg/kg)		Potassium (mg/kg)		Selenium (mg/kg)		Silver (mg/kg)		Sodium (mg/kg)		Thallium (mg/kg)		Vanadium (mg/kg)
1790 SB310000026.000	G22813	U	0.1100		30.6000	B	548.0000	J4	U N	0.2200	UJ	U	1.3000	B	287.0000	U	0.4400	34.4000
1791 SB310000027.000	G22814	U	0.1200		31.2000	B	603.0000	J4	U N	0.2400	UJ	U	1.4000	B	252.0000	U	0.4800	36.7000
1794 SB310000029.000	G22815	U	0.1200		30.3000	B	550.0000	J4	U N	0.2500	UJ	U	1.5000	B	255.0000	U	0.5000	30.6000

	STF Number	Lab Number	Zinc (mg/kg)	Boron (mg/kg)	Hardness SM 2340B (mg/kg)
1790	SB318000024.000	S22813	30.8000	0.0000	0.0000
1791	SB318000027.000	S22814	31.6000	0.0000	0.0000
1794	SB318000029.000	S22815	33.2000	0.0000	0.0000

Analytical data for METALS for file AMSBM.DBF 06/12/92 23:00:00 9,626 bytes
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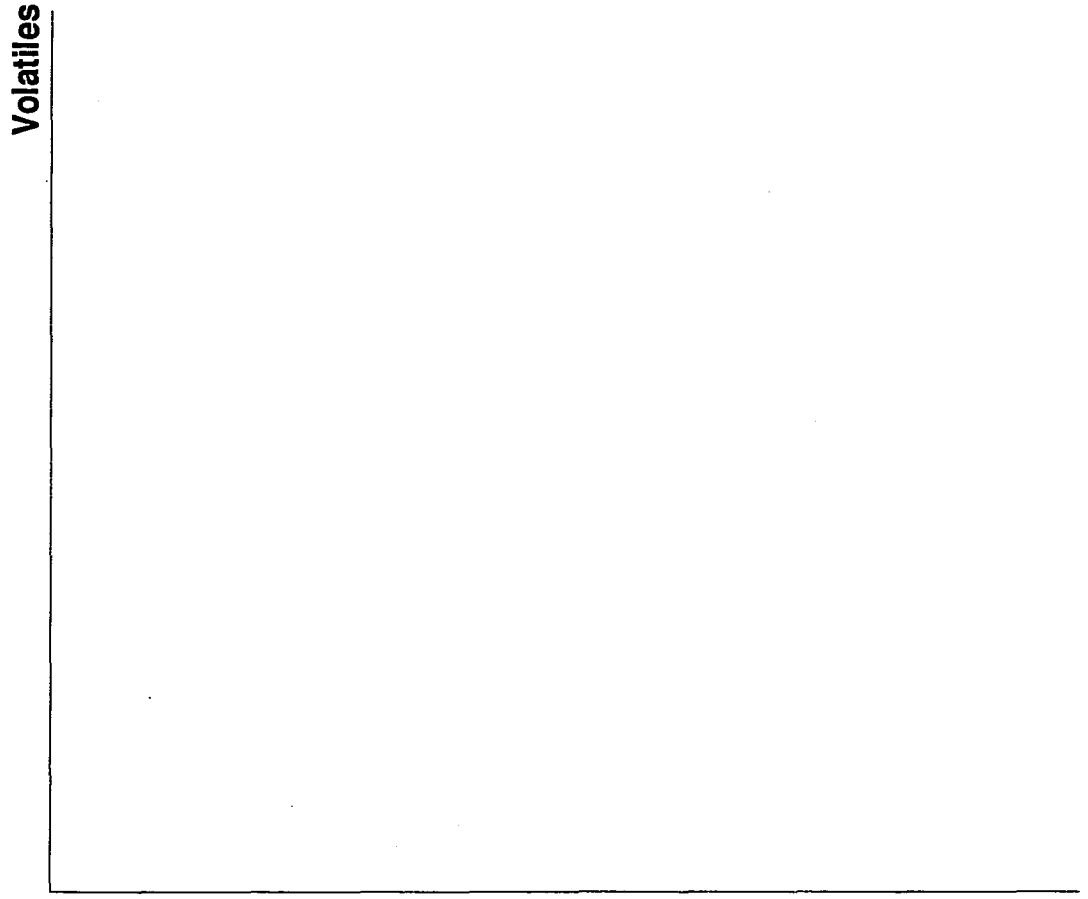
TABLE E-1

TOTAL PETROLEUM HYDROCARBONS
DATA SUMMARY

Laboratory Number	ID Number	Total Petroleum Hydrocarbons (mg/kg)
9203-112-1	1790SB310000024.001	5,300
9203-205-1	1791SB310000027.001	U 20
9203-205-2	1794SB310000029.501	1,800

Appendix F

Groundwater Analytical Results



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Analytical data for VOLATILES for file AMGUV.DBF 07/06/92 23:00:00 12,014 bytes

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STF Number	Lab Number	Chloromethane (ug/L)	Bromomethane (ug/L)	Vinyl Chloride (ug/L)	Chloroethane (ug/L)	Methylene Chloride (ug/L)	Acetone (ug/L)	Carbon Disulfide (ug/L)	1,1-Dichloroethene (ug/L)
1773 GU000000027.000	9205-049-5	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1775 GU000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1789 GU201000042.000	9205-049-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1790 GU310000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	JB 3.0000 UJ	U 10.0000 UJ	U 10.0000	U 10.0000
1791 GU310000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1792 GU000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1792 GU000000042.000	9205-049-8R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	JB 5.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
1793 GU000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
1795 GU310000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	JB 2.0000 UJ	U 10.0000 UJ	U 10.0000	U 10.0000
1795 GU310000042.000	9205-049-7R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
2000 GU202000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
3730 WW000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000
3739 WW000003000.000	9205-049-4	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000 UJ	U 10.0000	U 10.0000

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Analytical data for VOLATILES for file AMGUV.DBF 07/06/92 23:00:00 12,014 bytes

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STF Number	Lab Number	1,1-Dichloroethane (ug/L)	1,2-Dichloroethene (total) (ug/L)	Chloroform (ug/L)	1,2-Dichloroethane (ug/L)	2-Butanone (ug/L)	1,1,1-Trichloroethane (ug/L)	Carbon Tetrachloride (ug/L)	Bromodichloromethane (ug/L)
1773 GU0000000027.000	9205-049-5	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2010000042.000	9205-049-2	U 10.0000	U 10.0000	J 2.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1790 GU3100000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3100000041.000	9205-049-10	U 10.0000	U 10.0000	J 2.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 10.0000	J 2.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8R	U 10.0000 R	U 10.0000 R	J 2.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
1793 GU0000000042.000	9205-049-6	U 10.0000	U 10.0000	J 2.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
2000 GU2020000042.000	9205-049-3	U 10.0000	U 10.0000	J 2.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3738 WW0000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3739 WW0000003000.000	9205-049-4	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

Analytical data for VOLATILES for file AMGUV.DBF 07/06/92 23:00:00 12,014 bytes
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STF Number	Lab Number	1,2-Dichloropropane (ug/L)	cis-1,3-Dichloropropene (ug/L)	Trichloroethene (ug/L)	Dibromochloromethane (ug/L)	1,1,2-Trichloroethane (ug/L)	Benzene (ug/L)	trans-1,3-Dichloropropene (ug/L)	Bromoform (ug/L)
1773 GU0000000027.000	9205-049-5	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2010000042.000	9205-049-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0500	U 10.0000	U 10.0000	U 10.0000
1790 GU3100000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3100000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
1793 GU0000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
2000 GU2020000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3730 WW0000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3739 WW0000003000.000	9205-049-4	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

STF Number	Lab Number	4-Methyl-2-pentanone (ug/L)	2-Hexanone (ug/L)	Tetrachloroethene (ug/L)	Toluene (ug/L)	1,1,2,2-Tetrachloroethane (ug/L)	Chlorobenzene (ug/L)	Ethyl Benzene (ug/L)	Styrene (ug/L)
1773 GW000000027.000	9205-049-5	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1775 GW000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GW201000042.000	9205-049-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1790 GW310000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GW310000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GW000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GW000000042.000	9205-049-8R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
1793 GW000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GW310000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GW310000042.000	9205-049-7R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R	U 10.0000 R
2888 GW202000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3738 WW000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	J 1.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3739 WW000003000.000	9205-049-4	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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Analytical data for TICS FOR VOLATILES for file AMGUVT.DBF 07/06/92 23:00:00 10,351 bytes

07/06/92

STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/L)	Validation
1773GU000000027.000	9205-049-5	HEXANE	JNB	6.00	R
1775GU000000025.000	9205-049-1	HEXANE	JNB	8.00	R
1789GU201000042.000	9205-049-2	HEXANE	JNB	6.00	R
1790GU310000042.000	9205-049-11	HEXANE	JNB	6.00	R
		2,3-DIHYDRO-1-METHYLINDENE	JN	8.00	
		1H-INDENE, 2,3-DIHYDRO-1,6D	JN	9.00	
		IH-INDENE, 2,3-DIHYDRO-1,3D	JN	7.00	
1791GU310000041.000	9205-049-10	HEXANE	JNB	7.00	R
1792GU000000042.000	9205-049-8	HEXANE	JNB	6.00	R
1793GU000000042.000	9205-049-6	HEXANE	JNB	6.00	R
1795GU310000042.000	9205-049-7	HEXANE	JNB	6.00	R
2000GU202000042.000	9205-049-3	HEXANE	JNB	7.00	R
3730WW000002000.000	9205-049-9	HEXANE	JNB	8.00	R
3739WW000003000.000	9205-049-4	HEXANE	JNB	6.00	R

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Analytical data for TICS FOR VOLATILES for file AMGUVT.DBF 07/06/92 23:00:00 10,351 bytes

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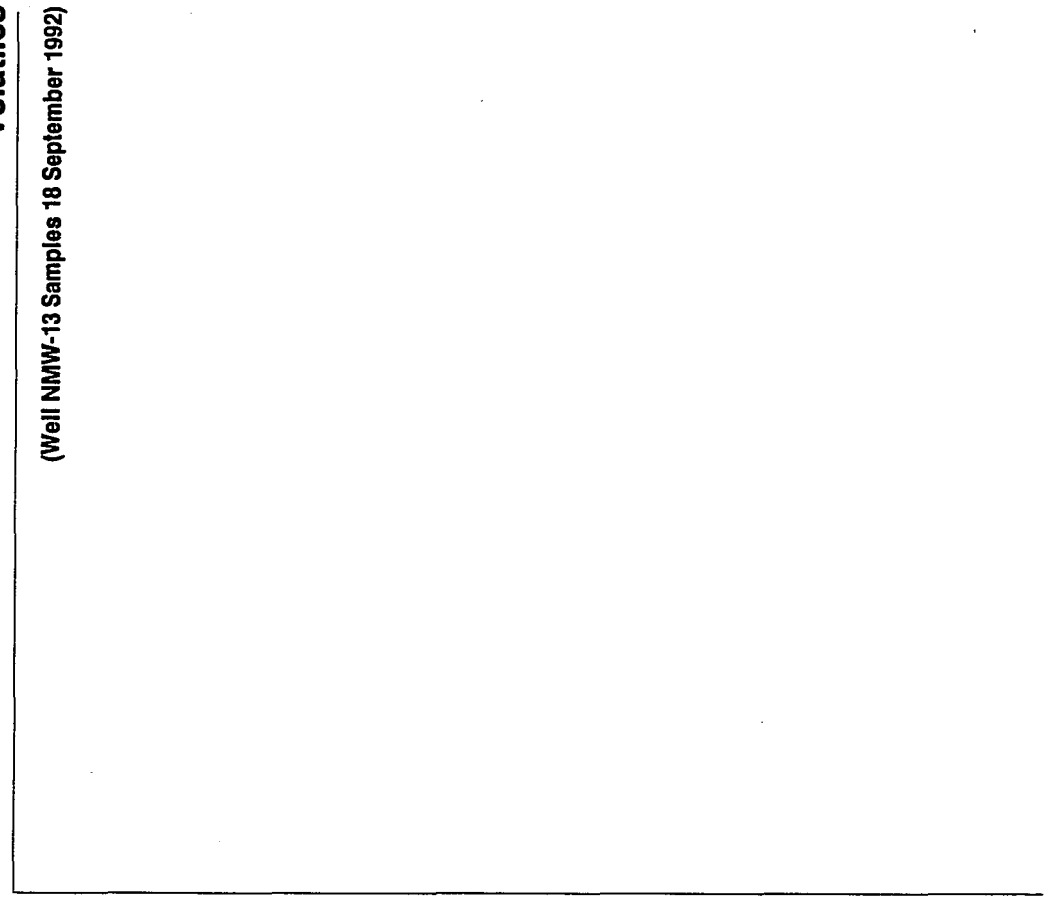
STF Number	Lab Number	Xylenes (total) (ug/L)		
1773 GU0000000027.000	9205-049-5	U	10.0000	
1775 GU0000000025.000	9205-049-1	U	10.0000	
1789 GU2810000042.000	9205-049-2	U	10.0000	
1790 GU3100000042.000	9205-049-11	U	10.0000	
1791 GU3100000041.000	9205-049-10	U	10.0000	
1792 GU0000000042.000	9205-049-8	U	10.0000	
1792 GU0000000042.000	9205-049-8R	U	10.0000	R
1793 GU0000000042.000	9205-049-6	U	10.0000	
1795 GU3100000042.000	9205-049-7	U	10.0000	
1795 GU3100000042.000	9205-049-7R	U	10.0000	R
2888 GU2820000042.000	9205-049-3	U	10.0000	
3738 WW0000002000.000	9205-049-9	U	10.0000	
3739 WW0000003000.000	9205-049-4	U	10.0000	



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Analytical data for VOLATILES for file AMGUV2.DBF 12/04/92 23:00:00 5,018 bytes

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STF_Number	Lab_Number	Chloromethane (ug/L)	Bromomethane (ug/L)	Vinyl Chloride (ug/L)	Chloroethane (ug/L)	Methylene Chloride (ug/L)	Acetone (ug/L)	Carbon Disulfide (ug/L)	1,1-Dichloroethene (ug/L)
1734 3U0000000000.000	9209-194-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1734 4U0000002000.000	9209-194-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STE Number	Lab Number	1,1-Dichloroethane (ug/L)	1,2-Dichloroethene (total) (ug/L)	Chloroform (ug/L)	1,2-Dichloroethane (ug/L)	2-Butanone (ug/L)	1,1,1-Trichloro-ethane (ug/L)	Carbon Tetrachloride (ug/L)	Bromodichloro-methane (ug/L)
1794 S1000000000.000	9209-194-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	J 9.0000 J	U 10.0000	U 10.0000	U 10.0000
1794 S1000002000.000	9209-194-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	B 18.0000 UJ	U 10.0000	U 10.0000	U 10.0000

Analytical data for VOLATILES for file AMGUV2.DBF 12/04/92 23:00:00 5,018 bytes

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Analytical data for VOLATILES for file AMGUV2.DBF 12/04/92 23:00:00 5,018 bytes

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STF Number	Lab Number	1,2-Dichloro-propane (ug/L)	cis-1,3-Dichloro-propene (ug/L)	Trichloroethene (ug/L)	Dibromochloro-methane (ug/L)	1,1,2-Trichloro-ethane (ug/L)	Benzene (ug/L)	Trans-1,3-Dichloropropene (ug/L)	Bromoform (ug/L)
1754 [illegible]000000000.000	9209-194-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1754 [illegible]000002000.000	9209-194-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

Analytical data for VOLATILES for file AMGUV2.DBF 12/04/92 23:00:00 5,018 bytes

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Analytical data for VOLATILES for file AMGUV2.DBF 12/04/92 23:00:00 5,018 bytes

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STF Number	Lab Number	4-Methyl-2-pentanone (ug/L)	2-Hexanone (ug/L)	Tetrachloroethene (ug/L)	Toluene (ug/L)	1,1,2,2-Tetrachloroethane (ug/L)	Chlorobenzene (ug/L)	Ethyl Benzene (ug/L)	Styrene (ug/L)
1734 SU000000000.000	9209-194-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1734 SW000002000.000	9209-194-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	Xylenes (total) (ug/L)	
1734 EJ0000000060.000	9209-194-1	U	10.0000
1734 HH0C0002000.000	9209-194-2	U	10.0000

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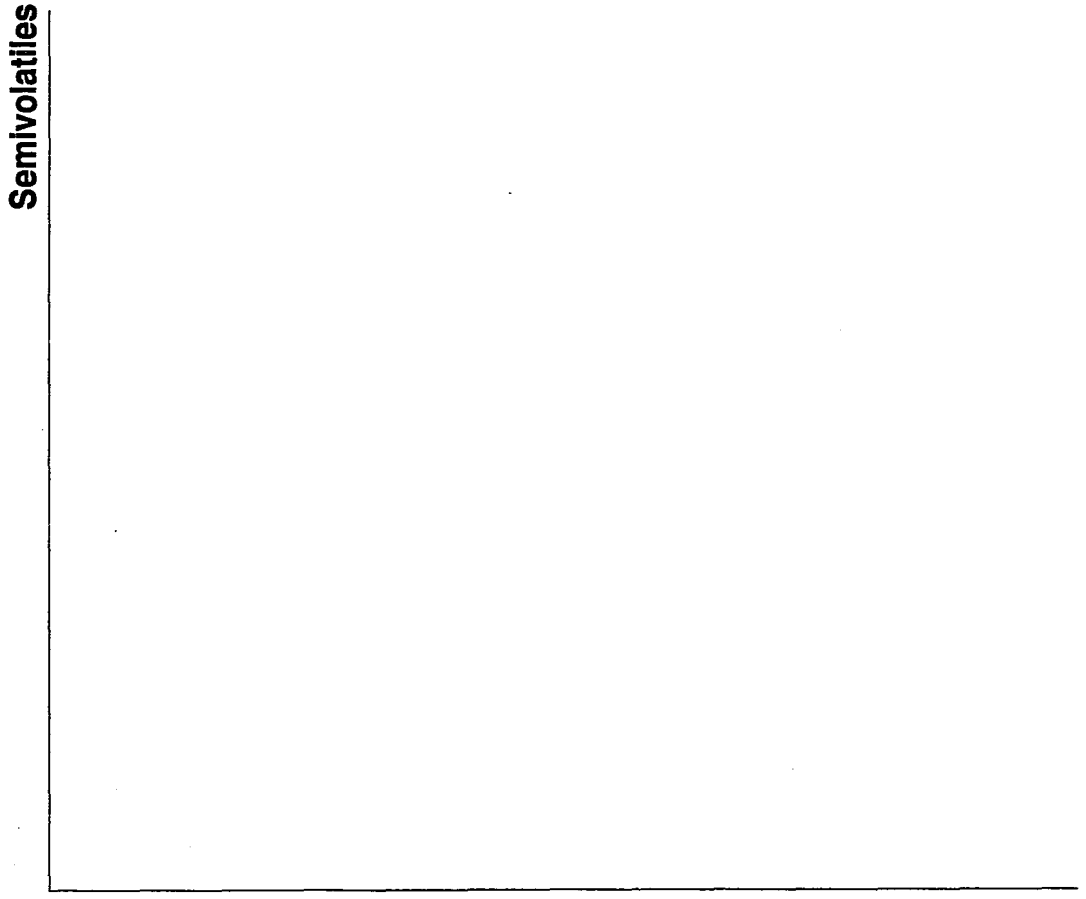

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07/06/92 Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

STF Number	Lab Number	Phenol (ug/L)	bis(2-Chloro-ethyl) ether (ug/L)	2-Chlorophenol (ug/L)	1,3-Dichloro-benzene (ug/L)	1,4-Dichloro-benzene (ug/L)	1,2-Dichloro-benzene (ug/L)	2-Methylphenol (ug/L)	2,2'-oxybis (1-Chloropropane) (ug/L)
1773 GU0000000027.000	9205-049-5	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2810000042.000	9205-049-2	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1790 GU3180000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3180000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1793 GU0000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3180000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
2000 GU2820000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3730 WW0000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	4-Methylphenol (ug/L)	N-Nitroso-di-n-dipropylamine (ug/L)	Hexachloroethane (ug/L)	Nitrobenzene (ug/L)	Isophorone (ug/L)	2-Nitrophenol (ug/L)	2,4-Dimethylphenol (ug/L)	bis(2-Chloro-ethoxy) methane (ug/L)
1773 GU0000000027.000	9205-049-5	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2810000042.000	9205-049-2	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1790 GU3160000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3160000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1793 GU0000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3160000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
2888 GU2020000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3730 WW0000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

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STF Number	Lab Number	2,4-Dichlorophenol (ug/L)		1,2,4-Trichlorobenzene (ug/L)		Naphthalene (ug/L)		4-Chloroaniline (ug/L)		Hexachlorobutadiene (ug/L)		4-Chloro-3-methylphenol (ug/L)		2-Methylnaphthalene (ug/L)		Hexachlorocyclopentadiene (ug/L)	
1773 GU0000000027.000	9205-049-5	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000
1775 GU0000000025.000	9205-049-1	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000 UJ
1789 GU2010000042.000	9205-049-2	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000 UJ
1790 GU3180000042.000	9205-049-11	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1791 GU3180000041.000	9205-049-10	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1792 GU0000000042.000	9205-049-8	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1793 GU0000000042.000	9205-049-6	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000 UJ
1795 GU3180000042.000	9205-049-7	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000 UJ
2000 GU2020000042.000	9205-049-3	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000 UJ
3730 WW0000002000.000	9205-049-9	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000

Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

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Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

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STP Number	Lab Number	2,4,6-Trichlorophenol (ug/L)	2,4,5-Trichlorophenol (ug/L)	2-Chloronaphthalene (ug/L)	2-Nitroaniline (ug/L)	Dimethylphthalate (ug/L)	Acenaphthylene (ug/L)	2,6-Dinitrotoluene (ug/L)	3-Nitroaniline (ug/L)
1773 GU0000000027.000	9205-049-5	U 11.0000	U 27.0000	U 11.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 27.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 25.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000
1789 GU2010000042.000	9205-049-2	U 11.0000	U 27.0000	U 11.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 27.0000
1790 GU3100000042.000	9205-049-11	U 10.0000	U 25.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000
1791 GU3160000041.000	9205-049-10	U 10.0000	U 25.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 26.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000
1793 GU0000000042.000	9205-049-6	U 10.0000	U 25.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000
1795 GU3100000042.000	9205-049-7	U 10.0000	U 26.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000
2000 GU2020000042.000	9205-049-3	U 10.0000	U 26.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000
3730 WW0000020000.000	9205-049-9	U 10.0000	U 25.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000

Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

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07/06/92 Analytical data for SEMIVOLATILES for file AMGUSV.DBF 07/06/92 23:00:00 18,042 bytes

STP Number	Lab Number	Acenaphthene (ug/L)	2,4-Dinitrophenol (ug/L)	4-Nitrophenol (ug/L)	Dibenzofuran (ug/L)	2,4-Dinitrotoluene (ug/L)	Diethylphthalate (ug/L)	4-Chlorophenyl-phenylether (ug/L)	Fluorene (ug/L)
1773 GU0000000027.000	9205-049-5	U 11.0000	U 27.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2010000042.000	9205-049-2	U 11.0000	U 27.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1790 GU3100000042.000	9205-049-11	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3100000041.000	9205-049-10	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1793 GU0000000042.000	9205-049-6	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7	U 10.0000	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
2000 GU2020000042.000	9205-049-3	U 10.0000	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3738 WW0000002000.000	9205-049-9	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF	Number	Lab Number	4-Nitroaniline (ug/L)	4,6-Dinitro-2-methylphenol (ug/L)	N-nitrosodiphenyl-amine (ug/L)	4-Bromophenyl-phenylether (ug/L)	Hexachlorobenzene (ug/L)	Pentachlorophenol (ug/L)	Phenanthrene (ug/L)	Anthracene (ug/L)
1773	GU0000000027.000	9205-049-5	U 27.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 27.0000	U 11.0000	U 11.0000
1775	GU0000000025.000	9205-049-1	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000
1789	GU2810000042.000	9205-049-2	U 27.0000	U 27.0000	U 11.0000	U 11.0000	U 11.0000	U 27.0000	U 11.0000	U 11.0000
1790	GU3100000042.000	9205-049-11	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000
1791	GU3100000041.000	9205-049-10	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000
1792	GU0000000042.000	9205-049-8	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000
1793	GU0000000042.000	9205-049-6	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000
1795	GU3100000042.000	9205-049-7	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000
2800	GU2820000042.000	9205-049-3	U 26.0000	U 26.0000	U 10.0000	U 10.0000	U 10.0000	U 26.0000	U 10.0000	U 10.0000
3730	WW0000002000.000	9205-049-9	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	Carbazole (ug/L)	Di-n-butyl-phthalate (ug/L)	Fluoranthene (ug/L)	Pyrene (ug/L)	Butylbenzyl-phthalate (ug/L)	3,3'-Dichloro-benzidine (ug/L)	Benzo(a)anthracene (ug/L)	Chrysene (ug/L)
1773 GU0000000027.000	9205-049-5	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1775 GU0000000025.000	9205-049-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1789 GU2010000042.000	9205-049-2	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000	U 11.0000
1790 GU3100000042.000	9205-049-11	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1791 GU3100000041.000	9205-049-10	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1792 GU0000000042.000	9205-049-8	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1793 GU0000000042.000	9205-049-6	U 10.0000	U 10.0000	U 10.0000	U 10.5000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1795 GU3100000042.000	9205-049-7	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
2000 GU2020000042.000	9205-049-3	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
3730 WW0000002000.000	9205-049-9	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STP Number	Lab Number	bis(2-Ethylhexyl) phthalate (ug/L)		Di-n-octyl-phthalate (ug/L)		Benzo(b)-fluoranthene (ug/L)		Benzo(k)-fluoranthene (ug/L)		Benzo(a)pyrene (ug/L)		Indeno(1,2,3-cd)-pyrene (ug/L)		Dibenzo(a,h)-anthracene (ug/L)		Benzo(g,h,i)-perylene (ug/L)	
1773 GU0000000027.000	9205-049-5	J	0.6000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000
1775 GU0000000025.000	9205-049-1	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1789 GU2010000042.000	9205-049-2	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000	U	11.0000
1790 GU3180000042.000	9205-049-11	J	3.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1791 GU3180000041.000	9205-049-10	J	0.8000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1792 GU0000000042.000	9205-049-8	J	0.6000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1793 GU0000000042.000	9205-049-6	J	0.7000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1795 GU3180000042.000	9205-049-7	J	0.7000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
2000 GU2020000042.000	9205-049-3	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
3730 WW0000002000.000	9205-049-9		33.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/L)	Validation
1773GU000000027.000	9205-049-5	Unknown Hydrocarbon	JNB	8.00	R
		Unknown Hydrocarbon	JNB	11.00	R
		Unknown Hydrocarbon	JNB	11.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Cyclohexane, 1-ethyl-2,3-dim	JN	3.00	
		Unknown Hydrocarbon	JN	4.00	
		Unknown Hydrocarbon	JN	4.00	
		Phenol, 2,6-bis(1,1-dimethyl	JNB	3.00	R
1775GU000000025.000	9205-049-1	Unknown Hydrocarbon	JNB	8.00	R
		Unknown Hydrocarbon	JNB	22.00	R
		Unknown Hydrocarbon	JNB	16.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R
1789GU201000042.000	9205-049-2	Unknown Hydrocarbon	JNB	8.00	R
		Unknown Hydrocarbon	JNB	15.00	R
		Unknown Hydrocarbon	JNB	17.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R
1790GU310000042.000	9205-049-11	Unknown Hydrocarbon	JNB	5.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Unknown Hydrocarbon	JNB	6.00	R
		Unknown Hydrocarbon	JN	2.00	
		Unknown Hydrocarbon	JN	3.00	
		Unknown Hydrocarbon	JN	2.00	
		Phenol, 2,6-bis(1,1-dimethyl	JNB	4.00	R
1791GU310000041.000	9205-049-10	Unknown Hydrocarbon	JNB	5.00	R
		Unknown Hydrocarbon	JNB	22.00	R
		Unknown Hydrocarbon	JNB	16.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		PHENOL, 2,6-BIS(1,1-DIMETHYL	JNB	2.00	R
1792GU000000042.000	9205-049-8	Unknown Hydrocarbon	JNB	10.00	R
		Unknown Hydrocarbon	JNB	16.00	R
		Unknown Hydrocarbon	JNB	14.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R
1793GU000000042.000	9205-049-6	Unknown Hydrocarbon	JNB	12.00	R
		2-Cyclohexen-1-one	JN	3.00	
		Unknown Hydrocarbon	JNB	18.00	R
		Unknown Hydrocarbon	JNB	16.00	R
		Unknown Hydrocarbon	JNB	4.00	R
1795GU310000042.000	9205-049-7	Unknown Hydrocarbon	JNB	7.00	R
		Unknown Hydrocarbon	JNB	13.00	R
		Unknown Hydrocarbon	JNB	15.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Ethane, 1,1'-oxybis[2-methox	JN	5.00	
		Unknown Hydrocarbon	JN	2.00	
2000GU202000042.000	9205-049-3	Unknown Hydrocarbon	JNB	9.00	R
		Unknown Hydrocarbon	JNB	19.00	R
		Unknown Hydrocarbon	JNB	14.00	R
		Unknown Hydrocarbon	JNB	4.00	R
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/L)	Validation
3730WW000002000.000	9205-049-9	Unknown Hydrocarbon	JNB	6.00	R
		Unknown Hydrocarbon	JNB	24.00	R
		Unknown Hydrocarbon	JNB	20.00	R
		Unknown Hydrocarbon	JN	2.00	
		Unknown Hydrocarbon	JNB	4.00	R
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R
		Unknown Hydrocarbon	JN	2.00	

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Semivolatiles

(Well NMW-13 Sampled 18 September 1992)

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STF Number	Lab Number	Phenol (ug/L)	bis(2-Chloroethyl) ether (ug/L)	2-Chlorophenol (ug/L)	1,3-Dichlorobenzene (ug/L)	1,4-Dichlorobenzene (ug/L)	1,2-Dichlorobenzene (ug/L)	2-Methylphenol (ug/L)	2,2'-oxybis (1-Chloropropane) (ug/L)
1794 BL0000000000.000	9209-194-1	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1794 MW0000002000.000	9209-194-2	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	4-Methylphenol (ug/L)		N-Nitroso-di-n-dipropylamine (ug/L)		Hexachloroethane (ug/L)		Nitrobenzene (ug/L)		Isophorone (ug/L)		2-Nitrophenol (ug/L)		2,4-Dimethylphenol (ug/L)		bis(2-Chloroethoxy) methane (ug/L)	
1754 BL000000000.000	9209-194-1	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1754 WW000002000.000	9209-194-2	U	10.0000	U	10.0000	U	10.0000	U	10.0000	J	0.6000	U	10.0000	U	10.0000	U	10.0000

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STF Number	Lab Number	2,4-Dichlorophenol (ug/L)		1,2,4-Trichlorobenzene (ug/L)		Naphthalene (ug/L)		4-Chloroaniline (ug/L)		Hexachlorobutadiene (ug/L)		4-Chloro-3-methylphenol (ug/L)		2-Methylnaphthalene (ug/L)		Hexachlorocyclopentadiene (ug/L)	
1794 BU000000000.000	9209-194-1	U	10.0000	U	10.0000	J	3.0000	U	10.0000	U	10.0000	U	10.0000	J	5.0000	U	10.0000
1794 WA000002000.000	9209-194-2	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000

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STF Number	Lab Number	2,4,6-Trichlorophenol (ug/L)		2,4,5-Trichlorophenol (ug/L)		2-Chloronaphthalene (ug/L)		2-Nitroaniline (ug/L)		Dimethylphthalate (ug/L)		Acenaphthylene (ug/L)		2,6-Dinitrotoluene (ug/L)		3-Nitroaniline (ug/L)	
1794 SLM000500000.000	9205-194-1	U	10.0000	U	25.0000	U	10.0000	U	25.0000	U	10.0000	U	10.0000	U	10.0000	U	25.0000
1794 WW000002000.000	9205-194-2	U	10.0000	U	25.0000	U	10.0000	U	25.0000	J	0.6000	U	10.0000	U	10.0000	U	25.0000

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STF Number	Lab Number	Acenaphthene (ug/L)	2,4-Dinitrophenol (ug/L)	4-Nitrophenol (ug/L)	Dibenzofuran (ug/L)	2,4-Dinitrotoluene (ug/L)	Diethylphthalate (ug/L)	4-Chlorophenyl-phenylether (ug/L)	Fluorene (ug/L)
1794 GU000000000.000	9209-194-1	J 1.0000	U 25.0000	U 25.0000	J 0.5000	U 10.0000	U 10.0000	U 10.0000	J 2.0000
1794 MW000002000.000	9209-194-2	U 10.0000	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	4-Nitroaniline (ug/L)	4,6-Dinitro-2-methylphenol (ug/L)	N-Nitrosodiphenylamine (ug/L)	4-Bromophenyl-phenylether (ug/L)	Hexachlorobenzene (ug/L)	Pentachlorophenol (ug/L)	Phenanthrene (ug/L)	Anthracene (ug/L)
1794 GU000000000.000	9209-194-1	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	J 2.0000	U 10.0000
1794 WW000002000.000	9209-194-2	U 25.0000	U 25.0000	U 10.0000	U 10.0000	U 10.0000	U 25.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	Carbazole (ug/L)	Di-n-butyl-phthalate (ug/L)	Fluoranthene (ug/L)	Pyrene (ug/L)	Butylbenzyl-phthalate (ug/L)	3,3'-Dichloro-benzidine (ug/L)	Benzo(a)anthracene (ug/L)	Chrysene (ug/L)
1794 SU0000000000.000	9209-194-1	J 0.6000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000
1794 MW0000002000.000	9209-194-2	U 10.0000	J 0.5000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000	U 10.0000

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STF Number	Lab Number	bis(2-Ethylhexyl) phthalate (ug/L)		Di-n-octyl phthalate (ug/L)		Benzo(b) fluoranthene (ug/L)		Benzo(k) fluoranthene (ug/L)		Benzo(a)pyrene (ug/L)		Indeno(1,2,3-cd) pyrene (ug/L)		Dibenzo(a,h) anthracene (ug/L)		Benzo(g,h,i) perylene (ug/L)	
1754 SB000000000.000	9209-194-1	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000
1794 MW000002000.000	9209-194-2	J	2.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000	U	10.0000

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Analytical data for TICS FOR SEMIVOLATILES for file AMGUST2.DBF 12/04/92 23:00:00 6,484 bytes

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STF Number	Lab Number	Tentatively Identified Compounds	Qualifier	Concentration (ug/L)	Validation
1794GW000000000.000	9209-194-1	Unknown Hydrocarbon	JB	4.00	R
		1H-INDENE, 2,3-DIHYDRO-1-MET	JN	6.00	
		2,3,-DIHYDRO-1-METHYLIDENE	JN	9.00	
		Unknown Hydrocarbon	JB	7.00	R
		1H-INDENE, 2,3-DIHYDRO-1,1-D	JN	6.00	
		BENZENE, 1-PENTENYL-	JN	5.00	
		1H-INDENE, 2,3-DIHYDRO-4,7-D	JN	3.00	
		1H-INDENE, 2,3-DIHYDRO-1,3-D	JN	3.00	
		Unknown Hydrocarbon	JN	3.00	
		Unknown Hydrocarbon	JN	6.00	
		NAPHTHALENE, 1-METHYL-	JN	18.00	
		NAPHTHALENE, 1-ETHYL-	JN	4.00	
		NAPHTHALENE, 1,7-DIMETHYL-	JN	12.00	
		NAPHTHALENE, 1,2-DIMETHYL-	JN	10.00	
		NAPHTHALENE, 1,4-DIMETHYL-	JN	4.00	
		NAPHTHALENE, 2,3,6-TRIMETHYL	JN	5.00	
		NAPHTHALENE, 1,4,5-TRIMETHYL	JN	3.00	
		Unknown Hydrocarbon	JN	3.00	
		1-NAPHTHALENECARBOXYLIC ACID	JN	3.00	
		Unknown Hydrocarbon	JN	3.00	
1794WW000002000.000	9209-194-2	Cyclohexanone	JN	5.00	
		Ethanol, 2-butoxy-	JN	10.00	
		Unknown Hydrocarbon	JB	6.00	R
		BENZALDEHYDE	JN	3.00	
		Unknown Hydrocarbon	JB	6.00	R
		Unknown Hydrocarbon	JB	4.00	R
		3-Cyclohexene-1-methanol, .a	JN	2.00	
		Propanoic acid, 2-methyl-, 2	JN	2.00	
		Benzaldehyde, 4-hydroxy-3-me	JN	4.00	
		Phenol, 2,6-bis(1,1-dimethyl	JNB	2.00	R
		Unknown Hydrocarbon	JN	2.00	
		Unknown Hydrocarbon	JN	10.00	
		Unknown Hydrocarbon	JN	2.00	

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Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP.DBF 07/06/92 23:00:00 6,264 bytes

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STF Number	Lab Number	Naphthalene (ug/L)		Acenaphthylene (ug/L)		Acenaphthene (ug/L)		Fluorene (ug/L)		Phenanthrene (ug/L)		Anthracene (ug/L)		Fluoranthene (ug/L)		Pyrene (ug/L)	
1773 GU000000027.000	9205-049-5	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1775 GU000000025.000	9205-049-1	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1789 GU201000042.000	9205-049-2	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1790 GU310000042.000	9205-049-11	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1791 GU310000041.000	9205-049-10	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1792 GU000000042.000	9205-049-8	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1793 GU000000042.000	9205-049-6	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
1795 GU310000042.000	9205-049-7	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
2000 GU202000042.000	9205-049-3	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000
3750 WW000002000.000	9205-049-9	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000

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Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP.DBF 07/06/92 23:00:00 6,264 bytes

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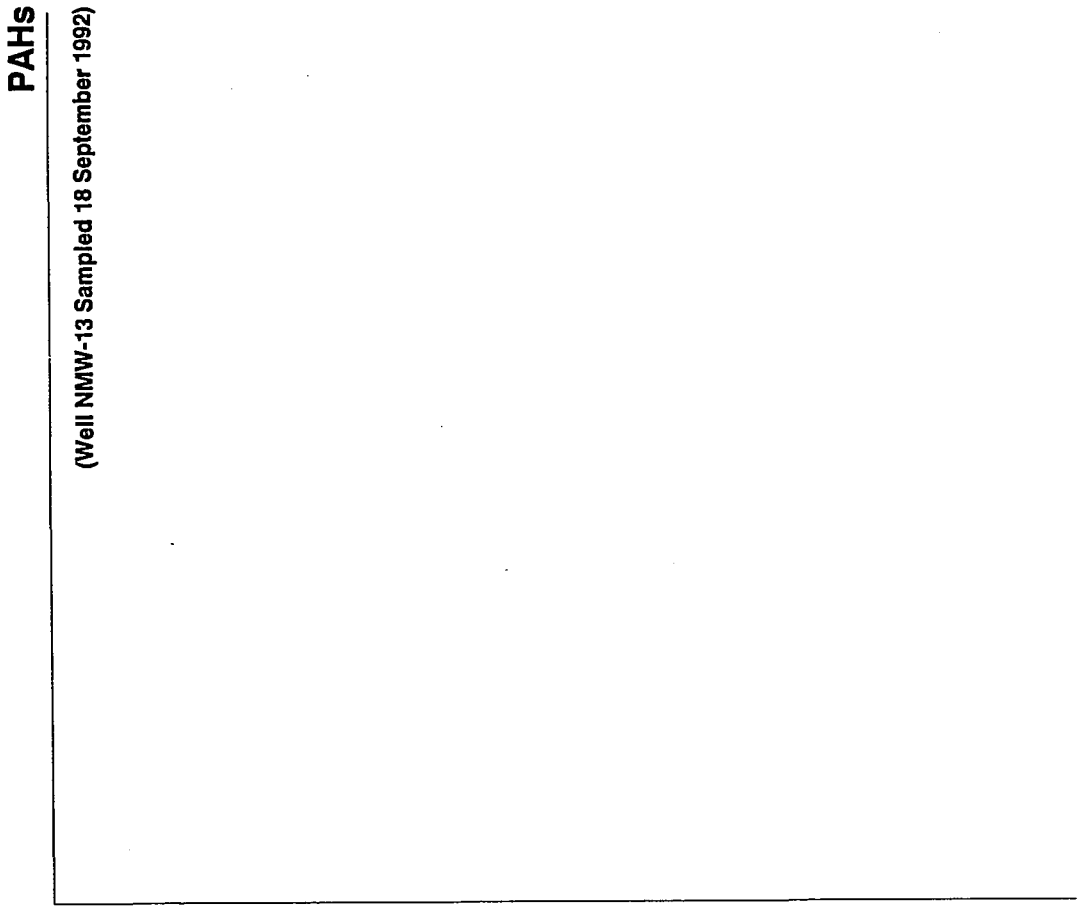
STF	Number	Lab Number	Benzo(a)anthracene (ug/L)		Chrysene (ug/L)		Benzo(b)-fluoranthene (ug/L)		Benzo(k)-fluoranthene (ug/L)		Benzo(a)pyrene (ug/L)		Indeno(1,2,3-cd)-pyrene (ug/L)		Dibenzo(a,h)-anthracene (ug/L)		Benzo(g,h,i)-perylene (ug/L)	
1773	GU0000000027.000	9205-049-5	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1775	GU0000000025.000	9205-049-1	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1789	GU2810000042.000	9205-049-2	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1790	GU3180000042.000	9205-049-11	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1791	GU3180000041.000	9205-049-10	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1792	GU0000000042.000	9205-049-8	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1793	GU0000000042.000	9205-049-6	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1795	GU3180000042.000	9205-049-7	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
2000	GU2820000042.000	9205-049-3	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
3730	WW0000002000.000	9205-049-9	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000



AMSTED

Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP2.DBF 12/04/92 23:00:00 2,944 bytes

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STF Number	Lab Number	Naphthalene (ug/L)		Acenaphthylene (ug/L)		Acenaphthene (ug/L)		Fluorene (ug/L)		Phenanthrene (ug/L)		Anthracene (ug/L)		Fluoranthene (ug/L)		Pyrene (ug/L)	
1754 SL000000000.000	9209-194-1	U	0.5000	U	1.0000	U	0.5000	U	0.1000		2.5000		0.0640		4.3000		4.0000
1754 WA000002000.000	9209-194-2	U	0.5000	U	1.0000	U	0.5000	U	0.1000	U	0.0500	U	0.0500	U	0.1000	U	0.1000

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Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP2.DBF 12/04/92 23:00:00 2,944 bytes

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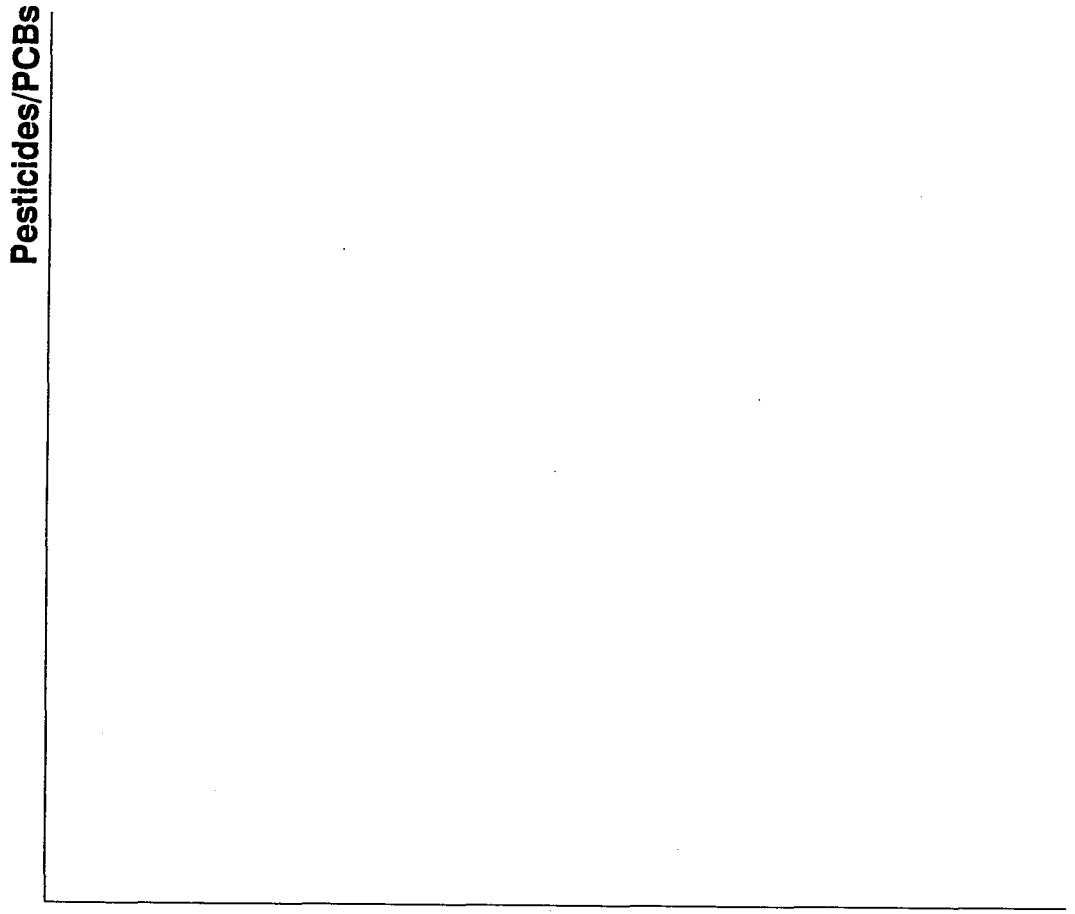
AMSTED

Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP2.DBF 12/04/92 23:00:00 2,944 bytes

STE Number	Lab Number	Benzo(a)anthracene (ug/L)		Chrysene (ug/L)		Benzo(b)-fluoranthene (ug/L)		Benzo(k)-fluoranthene (ug/L)		Benzo(a)pyrene (ug/L)		Indeno(1,2,3-cd)-pyrene (ug/L)		Dibenzo(a,h)-anthracene (ug/L)		Benzo(g,h,i)-perylene (ug/L)	
1754 SL0C0C000000.C00	9209-194-1	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000
1734 AM000002000.000	9209-194-2	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.2000	U	0.1000

Analytical data for POLYNUCLEAR AROMATIC HYDROCARBONS for file AMGUP2.DBF 12/04/92 23:00:00 2,944 bytes



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07/06/92 Analytical data for PESTICIDES/PCB for file AMGUPT.DBF 07/06/92 23:00:00 9,220 bytes

STF Number	Lab Number	alpha-BHC (ug/L)	beta-BHC (ug/L)	delta-BHC (ug/L)	gamma-BHC (Lindane) (ug/L)	Heptachlor (ug/L)	Aldrin (ug/L)	Heptachlor epoxide (ug/L)	Endosulfan I (ug/L)
1773 GU0000000027.000	9205-049-5	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510
1775 GU0000000025.000	9205-049-1	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520
1789 GUZ01000042.000	9205-049-2	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520	U 0.0520
1790 GU310000042.000	9205-049-11	U 0.0500	0.1300	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	0.3400
1791 GU310000041.000	9205-049-10	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500
1792 GU000000042.000	9205-049-8	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500
1793 GU0000000042.000	9205-049-6	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510	U 0.0510
1795 GU310000042.000	9205-049-7	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500	U 0.0500
2000 GUZ02000042.000	9205-049-3	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530
3738 WW0000002000.000	9205-049-9	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530	U 0.0530

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07/06/92 Analytical data for PESTICIDES/PCB for file AMGUPT.DBF 07/06/92 23:00:00 9,220 bytes

STF	Number	Lab Number	Dieldrin (ug/L)		4,4'-DDE (ug/L)		Endrin (ug/L)		Endosulfan II (ug/L)		4,4'-DDD (ug/L)		Endosulfan sulfate (ug/L)		4,4'-DDT (ug/L)		Methoxychlor (ug/L)	
1773	GU000000027.000	9205-049-5	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5100
1775	GU000000025.000	9205-049-1	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5200
1789	GU201000042.000	9205-049-2	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5200
1790	GU310000042.000	9205-049-11		0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5000
1791	GU310000041.000	9205-049-10	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5000
1792	GU000000042.000	9205-049-8	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5000
1793	GU000000042.000	9205-049-6	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5100
1795	GU310000042.000	9205-049-7	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.1000	U	0.5000
2888	GU202000042.000	9205-049-3	U	0.1100	U	0.1100	U	0.1100	U	0.1100	U	0.1100	U	0.1100	U	0.1100	U	0.5300
3730	WW000002000.000	9205-049-9	U	0.1100	U	0.1100	U	0.1100	U	0.1100	U	0.1000	U	0.1000	U	0.1100	U	0.5300

Analytical data for PESTICIDES/PCB for file AMGUPT.DBF 07/06/92 23:00:00 9,220 bytes
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STF Number	Lab Number	Endrin ketone (ug/L)		alpha-Chlordane (ug/L)		gamma-Chlordane (ug/L)		Toxephene (ug/L)		Aroclor-1016 (ug/L)		Aroclor-1221 (ug/L)		Aroclor-1232 (ug/L)		Aroclor-1242 (ug/L)	
1773 GU0000000027.000	9205-049-5	U	0.1000	U	0.5100	U	0.5100	U	1.0000	U	0.5100	U	0.5100	U	0.5100	U	0.5100
1775 GU0000000025.000	9205-049-1	U	0.1000	U	0.5200	U	0.5200	U	1.0000	U	0.5200	U	0.5200	U	0.5200	U	0.5200
1789 GU2010000042.000	9205-049-2	U	0.1000	U	0.5200	U	0.5200	U	1.0000	U	0.5200	U	0.5200	U	0.5200	U	0.5200
1790 GU3180000042.000	9205-049-11	U	0.1000	U	0.5000	U	0.5000	U	1.0000	U	0.5000	U	0.5000	U	0.5000	U	0.5000
1791 GU3180000041.000	9205-049-10	U	0.1000	U	0.5000	U	0.5000	U	1.0000	U	0.5000	U	0.5000	U	0.5000	U	0.5000
1792 GU0000000042.000	9205-049-8	U	0.1000	U	0.5000	U	0.5000	U	1.0000	U	0.5000	U	0.5000	U	0.5000	U	0.5000
1793 GU0000000042.000	9205-049-6	U	0.1000	U	0.5100	U	0.5100	U	1.0000	U	0.5100	U	0.5100	U	0.5100	U	0.5100
1795 GU3180000042.000	9205-049-7	U	0.1000	U	0.5000	U	0.5000	U	1.0000	U	0.5000	U	0.5000	U	0.5000	U	0.5000
2000 GU2020000042.000	9205-049-3	U	0.1100	U	0.5300	U	0.5300	U	1.1000	U	0.5300	U	0.5300	U	0.5300	U	0.5300
3730 WW0000002000.000	9205-049-9	U	0.1100	U	0.5300	U	0.5300	U	1.1000	U	0.5300	U	0.5300	U	0.5300	U	0.5300

Analytical data for PESTICIDES/PCB for file AMGUPT.DBF 07/06/92 23:00:00 9,220 bytes
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Analytical data for METALS for file AMGUM.DBF 07/06/92 23:00:00 18,789 bytes

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STF Number	Lab Number	Aluminum (ug/L)	Antimony (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Beryllium (ug/L)	Cadmium (ug/L)	Calcium (ug/L)	Chromium +3 (ug/L)
1773 GU0000000027.000	W24336	U 45.0000	U 20.0000	B 1.0000	B 4.4000	U 1.0000	U 3.0000	14800.0000	0.0000
1775 GU0000000025.000	W24337	B 114.0000	U 20.0000	B 4.4000	B 43.5000	U 1.0000	U 3.0000	9290.0000	0.0000
1789 GU2010000042.000	W24338	891.0000	B 23.6000	U 1.0000	B 14.8000	U 1.0000	U 3.0000	12600.0000	0.0000
1790 GU3180000042.000	W24339	B 98.0000	U 20.0000	U 1.0000	B 22.8000	U 1.0000	B 3.1000 UJ	35200.0000	0.0000
1791 GU3180000041.000	W24340	1090.0000	U 20.0000	U 1.0000	B 12.8000	U 1.0000	U 3.0000	18600.0000	0.0000
1792 GU0000000042.000	W24341	1180.0000	U 20.0000	U 1.0000	B 20.1000	U 1.0000	B 3.7000 UJ	30300.0000	0.0000
1793 GU0000000042.000	W24342	832.0000	U 20.0000	U 1.0000	B 11.1000	U 1.0000	U 3.0000	22900.0000	0.0000
1795 GU3180000042.000	W24343	833.0000	U 20.0000	U 1.0000	B 28.0000	U 1.0000	U 3.0000	18600.0000	0.0000
2000 GU2020000042.000	W24344	877.0000	U 20.0000	U 1.0000	B 14.3000	U 1.0000	U 3.0000	13000.0000	0.0000
3730 WW0000002000.000	W24345	U 45.0000	U 20.0000	U 1.0000	U 1.0000	U 1.0000	B 3.6000	U 127.0000	0.0000

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Analytical data for METALS for file AMGUM.DBF 07/06/92 23:00:00 18,789 bytes

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STP Number	Lab Number	Chromium +6 (ug/L)		Total Chromium (ug/L)		Cobalt (ug/L)		Copper (ug/L)		Iron (ug/L)		Lead (ug/L)		Magnesium (ug/L)		Manganese (ug/L)	
1773 GU0000000027.000	WZ4336	0.0000	U	5.0000	U	5.0000	U	1.0000	*	477.0000 J4	U WN	1.0000	B	4170.0000		154.0000
1775 GU0000000025.000	WZ4337	0.0000	U	5.0000	B	7.6000	U W	1.0000	*	2470.0000 J4	B WN	1.3000 J4	B	4230.0000		543.0000
1789 GU2010000042.000	WZ4338	0.0000	B	9.8000	B	5.0000	B W	3.4000 J4	*	1370.0000 J4	WN	3.9000 J4		11400.0000		74.6000
1790 GU3140000042.000	WZ4339	0.0000	B	5.1000	B	7.3000	B W	1.7000 J4	*	196.0000 J4	B WN	2.3000 J4		27100.0000		907.0000
1791 GU3140000041.000	WZ4340	0.0000	B	5.2000	B	5.3000	B W	2.3000 J4	*	1000.0000 J4	B WN	2.8000 J4		7530.0000		38.6000
1792 GU0000000042.000	WZ4341	0.0000		10.1000	B	7.0000	B W	2.1000 J4	*	1460.0000 J4	WN	3.9000 J4		11200.0000		61.0000
1793 GU0000000042.000	WZ4342	0.0000		10.1000	B	5.0000	B W	2.8000 J4	*	1140.0000 J4	B WN	2.8000 J4		9990.0000		31.3000
1795 GU3180000042.000	WZ4343	0.0000	U	5.0000	U	5.0000	B G	28.3000	*	1180.0000 J4	WN	13.9000 J4		11700.0000		121.0000
2000 GU2020000042.000	WZ4344	2.0000	B	9.4000	U	5.0000	B W	2.5000 J4	*	1380.0000 J4	WN	3.0000 J4		11400.0000		76.1000
3730 WV0000002000.000	WZ4345	0.0000	U	5.0000	U	5.0000	U	1.0000	U *	27.0000 UJ	B W	1.7000 J4	U	64.0000	U	3.0000

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07/06/92 Analytical data for METALS for file AMGUM.DBF 07/06/92 23:00:00 18,789 bytes

STF Number	Lab Number	Mercury (ug/L)		Nickel (ug/L)		Potassium (ug/L)		Selenium (ug/L)			Silver (ug/L)		Sodium (ug/L)		Thallium (ug/L)		Vanadium (ug/L)	
1773 GU0000000027.000	W24336	U	0.2000	B	10.8000	B	1170.0000	U WN	1.0000	UJ	U	6.0000	6150.0000	U	1.0000	U	5.0000
1775 GU0000000025.000	W24337	U	0.2000	U	8.0000	B	1790.0000	U WN	1.0000	UJ	U	6.0000	9860.0000	U	1.0000	U	5.0000
1789 GU2810000042.000	W24338	U	0.2000	B	24.2000	B	2310.0000	U WN	1.0000	UJ	U	6.0000	5760.0000	U	1.0000	B	5.3000
1790 GU3180000042.000	W24339	U	0.2000		43.2000	B	3230.0000	U WN	1.0000	UJ	U	6.0000	13000.0000	U	1.0000	U	5.0000
1791 GU3180000041.000	W24340	U	0.2000	B	26.9000	B	1530.0000	U WN	1.0000	UJ	U	6.0000	13300.0000	U	1.0000	B	5.3000
1792 GU0000000042.000	W24341	U	0.2000	B	15.6000	B	2570.0000	U WN	1.0000	UJ	U	6.0000	29600.0000	U	1.0000	B	7.0000
1793 GU0000000042.000	W24342	U	0.2000	B	11.8000	B	1780.0000	U WN	1.0000	UJ	U	6.0000	10100.0000	U	1.0000	U	5.0000
1795 GU3180000042.000	W24343	U	0.2000	U	8.0000	B	2780.0000	B WN	1.0000	J4	U	6.0000	27500.0000	U	1.0000	U	5.0000
2888 GU2820000042.000	W24344	U	0.2000	B	20.9000	B	2260.0000	U WN	1.0000	UJ	U	6.0000	5610.0000	U	1.0000	B	6.1000
3738 WW0000002000.000	W24345	U	0.2000	B	9.8000	U	746.0000	U WN	1.0000	UJ	U	6.0000	B 47.7000	U	1.0000	U	5.0000

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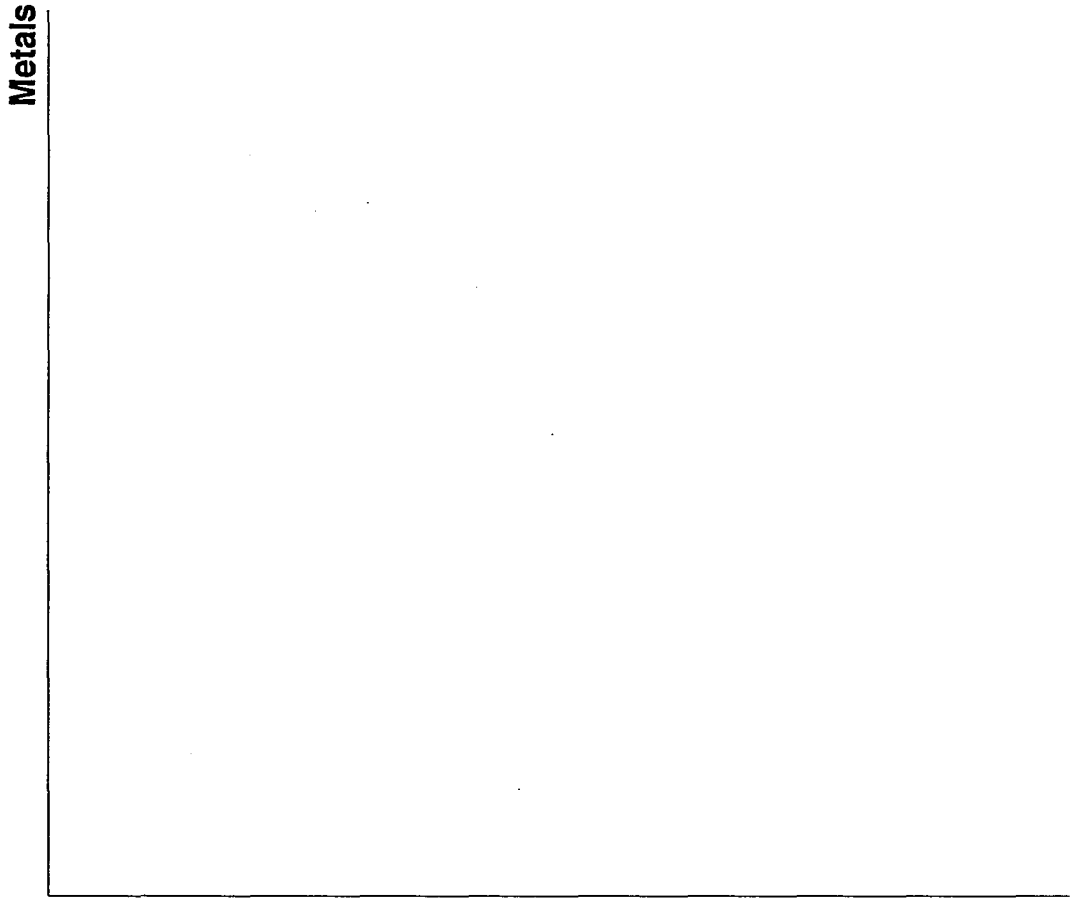
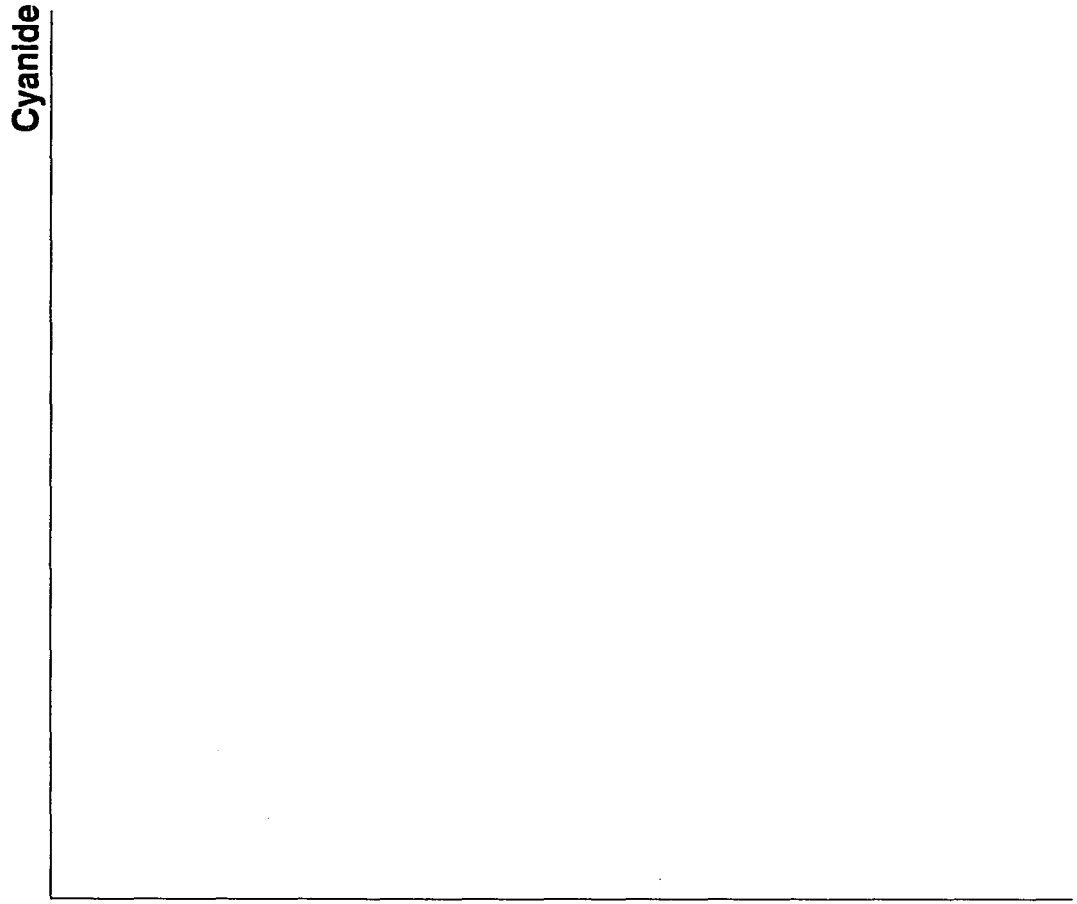
STF Number	Lab Number		Zinc (ug/L)	Boron (ug/L)	Hardness SM 2340B (mg/L)
1773 GU0000000027.000	W24336	*	42.6000 J4	49.6000 UJ	0.0000
1775 GU0000000025.000	W24337	B *	19.8000 UJ	96.8000	0.0000
1789 GU2810000042.000	W24338	*	63.5000 J4	191.0000	0.0000
1790 GU3140000042.000	W24339	B *	7.6000 UJ	53.7000 UJ	0.0000
1791 GU3140000041.000	W24340	B *	10.7000 UJ	53.0000 UJ	0.0000
1792 GU0000000042.000	W24341	B *	8.9000 UJ	107.0000	0.0000
1793 GU0000000042.000	W24342	B *	16.1000 UJ	65.6000	0.0000
1795 GU3140000042.000	W24343	*	28.7000 J4	130.0000	0.0000
2000 GU2820000042.000	W24344	B *	13.7000 UJ	191.0000	0.0000
3730 WW000002000.000	W24345	*	32.4000 J4	14.3000	0.0000

STF Number	Lab Number	Aroclor-1248 (ug/L)		Aroclor-1254 (ug/L)		Aroclor-1260 (ug/L)	
1773 GU000000027.000	9205-049-5	U	0.5100	U	1.0000	U	1.0000
1775 GU000000025.000	9205-049-1	U	0.5200	U	1.0000	U	1.0000
1789 GU201000042.000	9205-049-2	U	0.5200	U	1.0000	U	1.0000
1790 GU310000042.000	9205-049-11	U	0.5000	U	1.0000	U	1.0000
1791 GU310000041.000	9205-049-10	U	0.5000	U	1.0000	U	1.0000
1792 GU000000042.000	9205-049-8	U	0.5000	U	1.0000	U	1.0000
1793 GU000000042.000	9205-049-6	U	0.5100	U	1.0000	U	1.0000
1795 GU310000042.000	9205-049-7	U	0.5000	U	1.0000	U	1.0000
2000 GU202000042.000	9205-049-3	U	0.5300	U	1.1000	U	1.1000
3730 WW000002000.000	9205-049-9	U	0.5300	U	1.1000	U	1.1000

Analytical data for PESTICIDES/PCB for file AMGUPT.DBF 07/06/92 23:00:00 9,220 bytes
07/06/92 Page 4





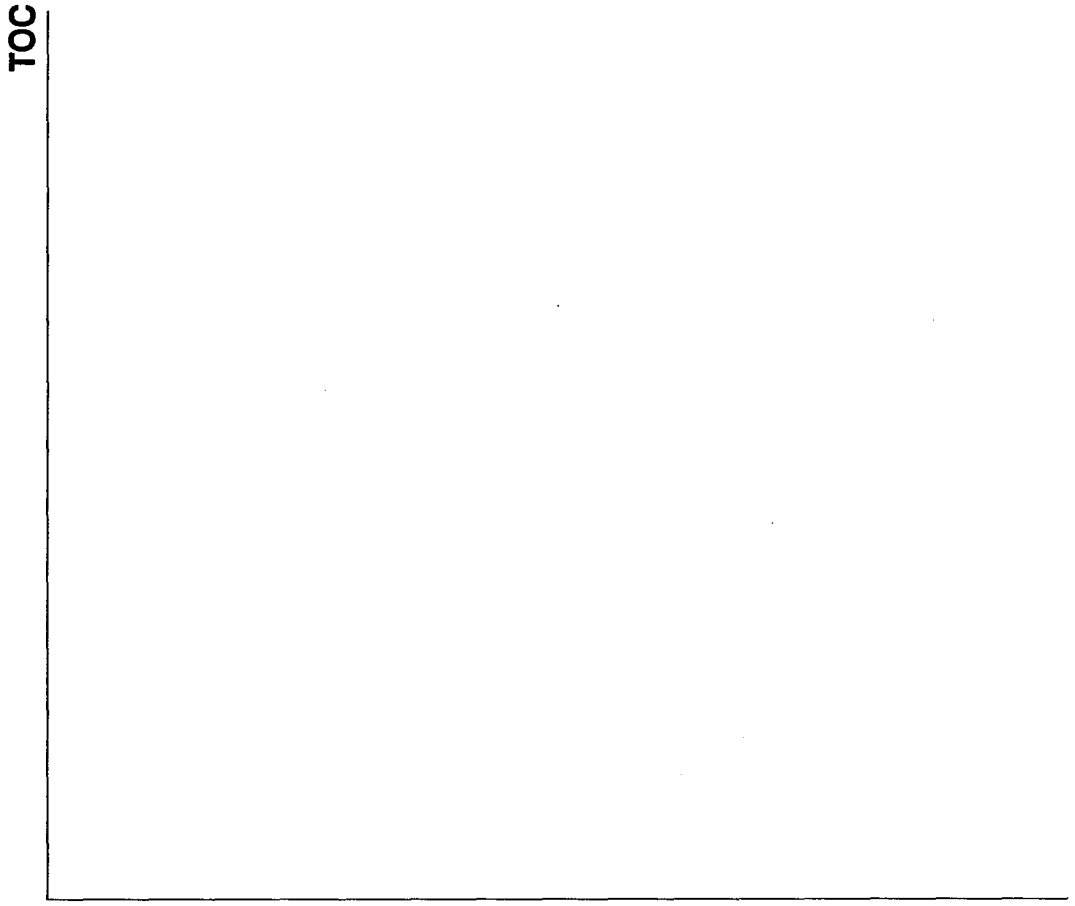
AMSTED

07/06/92 Analytical data for CYANIDE for file AMGUCN.DBF 07/06/92 23:00:00 2,719 bytes Page 1

STF Number	Lab Number		Cyanide (ug/L)
1773 GU0000000027.000	W24336	U	10.0000
1775 GU0000000025.000	W24337	U	10.0000
1789 GU2810000042.000	W24338	U	10.0000
1790 GU3110000042.000	W24339	U	10.0000
1791 GU3110000041.000	W24340	U	10.0000
1792 GU0000000042.000	W24341	U	10.0000
1793 GU0000000042.000	W24342	U	10.0000
1795 GU3110000042.000	W24343	U	10.0000
2808 GU2820000042.000	W24344	U	10.0000
3730 WW0000002000.000	W24345	U	10.0000

DATA VALIDATION
DATE RECEIVED_____
VALIDATED BY_____ DATE_____
KEYED BY_____ DATE_____
CHECKED BY [signature] DATE 7/6/92

07/06/92 Analytical data for CYANIDE for file AMGUCN.DBF 07/06/92 23:00:00 2,719 bytes Page 1



AMSTED

Analytical data for TOTAL ORGANIC CARBON for file AMGUOC.DBF 07/06/92 23:00:00 2,666 bytes

07/06/92 Page 1

STF Number	Lab Number		Total Organic Carbon (EPA 9060) (ug/L)
1773 GU0000000027.000	W24336		3400.0000
1775 GU0000000025.000	W24337		2000.0000
1789 GU2010000042.000	W24338		1600.0000
1790 GU3100000042.000	W24339		11200.0000
1791 GU3100000041.000	W24340		1600.0000
1792 GU0000000042.000	W24341		31600.0000
1793 GU0000000042.000	W24342	U	1000.0000
1795 GU3100000042.000	W24343	U	1000.0000
2000 GU2010000042.000	W24344		1470.0000
3738 WW000002000.000	W24345	U	1000.0000

DATA VALIDATION
DATE RECEIVED _____
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CHECKED BY _____ DATE 7/6/92

Analytical data for TOTAL ORGANIC CARBON for file AMGUOC.DBF 07/06/92 23:00:00 2,666 bytes

07/06/92 Page 1

TABLE F-1

TOTAL PETROLEUM HYDROCARBONS DATA SUMMARY

Laboratory Number	ID Number	Total Petroleum Hydrocarbons (mg/L)	
9205-049-5	1773GU000000027.000	U	1.0
9205-049-1	1775GU000000025.000	U	1.0
9205-049-2	1789GU201000042.000	U	1.0
9205-049-11	1790GU310000042.000	U	1.0
9205-049-10	1791GU310000041.000	U	1.0
9205-049-8	1792GU000000042.000	U	1.0
9205-049-6	1793GU000000042.000	U	1.0
9205-049-7	1795GU310000042.000	U	1.0
9205-049-3	2000GU202000042.000	U	1.0
9205-049-9	3730WW000002000.000	U	1.0

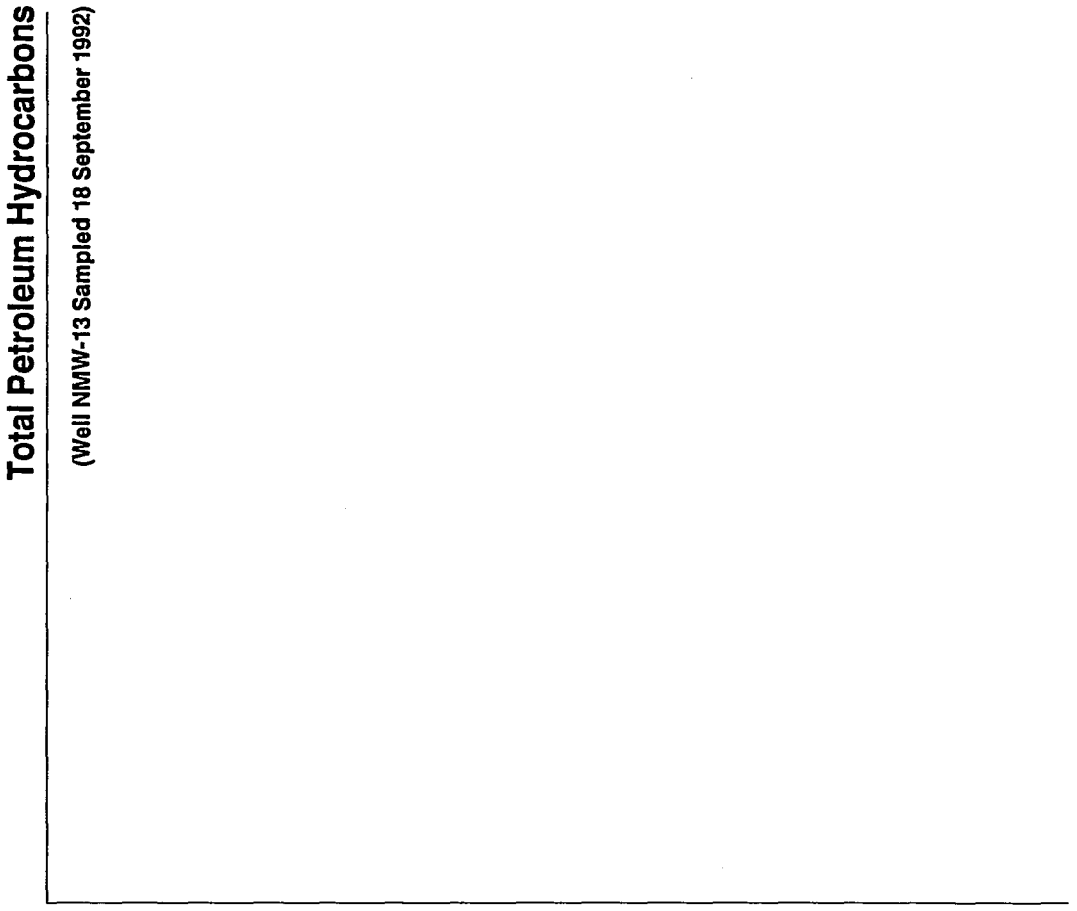

TABLE F-2

TOTAL PETROLEUM HYDROCARBONS DATA SUMMARY

Laboratory Number	ID Number	Total Petroleum Hydrocarbons (mg/L)	
9209-194-1	1794GU000000000.000	U	1.0
9209-194-2	1794WW000000000.000	U	1.0

AMSTED

Analytical data for TOTAL SUSPENDED AND TOTAL DISSOLVED SOLIDS for file AMGUTS.DBF 07/06/92 23:00:00 3,136 bytes
07/06/92 Page 1

STF Number	Lab Number	Total Dissolved Solids (EPA 105.1) (mg/L)	Total Suspended Solids (EPA 160.2) (mg/L)
1773 GU0000000027.000	9205-049-5	130.0000	U 10.0000
1775 GU0000000025.000	9205-049-1	150.0000	15.0000
1789 GU2810000042.000	9205-049-2	150.0000	36.0000
1790 GU3180000042.000	9205-049-11	280.0000	10.0000
1791 GU3180000041.000	9205-049-10	160.0000	62.0000
1792 GU0000000042.000	9205-049-8	260.0000	43.0000
1793 GU0000000042.000	9205-049-6	180.0000	22.0000
1795 GU3130000042.000	9205-049-7	220.0000	17.0000
2000 GU2020000042.000	9205-049-3	170.0000	38.0000
3730 WW0000002000.000	9205-049-9	27.0000	U 10.0000

DATA VALIDATION
DATE RECEIVED _____
VALIDATED BY _____ DATE _____
KEYED BY _____ DATE _____
CHECKED BY SJRM DATE 7/16/92

Analytical data for TOTAL SUSPENDED AND TOTAL DISSOLVED SOLIDS for file AMGUTS.DBF 07/06/92 23:00:00 3,136 bytes
07/06/92 Page 1

Appendix G

Validation Reports

Produce and Soil Validation Report

EcoChem, Inc.

DATA VALIDATION REPORT

Amsted Subsurface Investigation

Prepared for:

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Federal Way, Wa. 98003

Prepared by:

EcoChem, Inc.
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EcoChem Contract: 2306

June 12, 1992

Amsted Subsurface Investigation

CONTRACT LABORATORIES:

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DATA VALIDATION
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INTRODUCTION

The submitted data packages have been reviewed by EcoChem, Inc. Data validation packets for the organics and inorganics analyses, which detail items reviewed, are on file at EcoChem. The quality assurance evaluations performed and the resulting data qualification recommendations are summarized in the following sections:

- Volatile Organic Analyses
- Semivolatile Organic Analyses
- Pesticide/PCB Analyses
- PAH Analyses
- Total Metals Analyses

Recommended data qualifiers are based on the EPA Data Validation Functional Guidelines (U.S. EPA, 1988b, c, d). These guidelines require that the data reviewer use professional judgment to designate data qualifiers, but do not replace those assigned by the laboratory. Data may be qualified even though the laboratory fulfilled all the requirements stated in the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for a particular analysis (U.S. EPA, 1988a, 1990a, b). Unless specifically stated in the text, data qualifications are not due to laboratory error or deviations from the analysis protocols defined in the EPA SOW, but are based on EPA data validation guidelines.

EcoChem, Inc.'s goal in assigning data validation qualifiers is to assist in proper data interpretation. If values are assigned a J, or UJ, data can be used for site evaluation purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet all data quality goals as outlined in the EPA Functional Guidelines and as required by the South Tacoma Field Superfund Site Quality Assurance Project Plan, March, 1991.

Holding times, sample integrity and required analyses were determined by review of the chain-of-custody sheets. Chain-of-custody records were received for all samples. A summary of the samples reviewed is provided in Table 1.

Table 1. Summary of Analysis Reviewed.

Sample Number	VOA	BNA	Pest/ PCBs	Metals	PAH
1774PP000000000.000	2/27 01140"	2/27 01140"	2/27 01110"	2/27 01140"	2/27 01140"
1790SB310000024.001	5/11 03112V	5/11 03112		5/11 JOB303	
1791SB310000027.000	5/11 03205	5/11 03112		5/11 JOB303	
1794SB310000029.500	5/11 03205	5/11 03112		5/11 JOB303	

KEY

VOA	=	CLP Volatile Organic Compounds
BNA	=	Base/Neutral/Acid (Semivolatile) Compounds
P/PCB	=	TCL Pesticide Compounds and Polychlorinated Biphenyls Pesticides
Metals	=	TCL Metals
PAH	=	Polynuclear Aromatic Hydrocarbon

Note: If numbers noted in box, then sample results were reviewed. The first line in the box is the date sample results were received at EcoChem. The second line is the EcoChem sampling data group number used for file tracking purposes.

REFERENCES

Kennedy/Jenks/Chilton. 1991. Quality Assurance Project Plan South Tacoma Field Superfund Site, Tacoma, Wa. March.

U.S. Environmental Protection Agency. 1988a. Contract Laboratory Program Statement of Work for Pesticides/PCBs.

U.S. Environmental Protection Agency. 1988b. Functional Guidelines for Evaluating Inorganic Analyses.

U.S. Environmental Protection Agency. 1988c. Functional Guidelines for Evaluating Organic Analyses. R-582-5-5-01.

U.S. Environmental Protection Agency. 1988d. Functional Guidelines for Evaluating Pesticide/PCB Analyses. R-582-5-5-01.

U. S. Environmental Protection Agency. 1990a. Contract Laboratory Program Statements of Work for Inorganics. ILM01.0.

U. S. Environmental Protection Agency. 1990b. Contract Laboratory Program Statements of Work for Organics. OLM01.0.

NARRATIVE

DATA VALIDATION REPORT
VOLATILE ORGANIC ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. GC/MS Instrument Performance Check: ACCEPTABLE/All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Methylene Chloride	J4(+)	9203-205-1, 9203-205-2	Continuing calibration %D > 25%. (%D = 47.6%)
Methylene Chloride	J4(+)	9203-112-1	Continuing calibration %D > 25%. (%D = 35.0%)
Acetone	J4(+)	9203-205-1, 9203-205-2, 9203-112-1	Initial calibration %RSD > 30%. (%RSD = 44.2%)
2-Butanone	R(-)	9201-140-1, 9201-140-1DUP	Continuing calibration RRF50 < 0.05. (RRF50 = 0.041)

Discussion

The relative response factor (RRF) and the percent relative standard deviation (%RSD) for the initial calibration, and the RRF and percent difference (%D) for the calibration were evaluated. The five point calibration curve was established using different concentrations of standards for SDG 01140 than stated in the 1990 SOW. The laboratory analyzed the standards at the concentrations specified by the 1988 SOW. This was judged not to affect the results, and no qualifiers are recommended.

Criteria for %D, RRF50 and %RSD between calibrations were not met for compounds listed above. Functional Guidelines specifies positive results are assigned a J4 qualifier if initial calibration RSD is greater than 30%, and if %D for continuing calibration is greater than 25%. For significant %RSD of %D variations (>50%), detection limits are

also qualified (UJ). If the RRF is less than 0.05, then positive results are qualified as estimated (J4) and nondetects unusable (R). Qualifiers are summarized in the above table.

IV. Blank Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Methylene Chloride	UJ at Reported Value	9203-205-1, 9203-205-2, 9203-112-1, 9201-140-1DUP	Sample value < 10 x method blank concentration.
Acetone	UJ at Reported Value	9203-205-1, 9203-205-2, 9203-112-1, 9201-140-1, 9201-140-1DUP	Sample value < 10 x method blank concentration.

Discussion

Methylene chloride and acetone were detected in the laboratory method blanks. Because these are common laboratory contaminants, an action level is determined for data qualification at 10 times the highest associated blank value. Samples with concentrations less than the action level are qualified (UJ), and are listed in the above table.

The laboratory did not follow the CLP SOW for blank analyses, as method blank weights did not always match the associated sample weight. Therefore, to compare method blank results to sample results, results from the raw data instrument readouts were used, rather than Form I results.

V. Surrogate Recovery: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All volatile organic compounds	R	9201-140-1	Low surrogate recovery. Use duplicate results.

Discussion

Surrogate percent recovery (%R) for toluene-d8 was low (76%) for Sample 9201-140-1 indicating possible low biased results. A duplicate sample was analyzed with results within

control limits. It is recommended that the sample results for 9201-140-1 be rejected and the 9201-140-1DUP results be used instead.

VI. **Matrix Spike/Matrix Spike Duplicate Sample Analyses:** ACCEPTABLE/All criteria met.

VII. **Field Duplicates:** Not Submitted.

Discussion

A field duplicate was not submitted, but the laboratory performed the product sample analysis in duplicate. Surrogate recovery was low for one analyses (9201-140-1), and relative percent differences (RPD) between the duplicates were high (12.5%-86.7%). Therefore, the results reported for Sample 9201-140-1DUP are recommended to be used rather than the inital results which may be biased low.

VIII. **Internal Standards Performance:** ACCEPTABLE/All criteria met.

IX. **Compound Identification:** ACCEPTABLE/All criteria met.

X. **Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):** ACCEPTABLE/All criteria met.

XI. **Tentatively Identified Compounds (TIC):** ACCEPTABLE/With the following exceptions.

Discussion

All TIC are flagged tentatively identified at estimated concentrations (JN).

XII. **System Performance:** ACCEPTABLE/All criteria met.

XIII. **Overall Assessment of the Data**

The data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
SEMIVOLATILE ORGANICS ANALYSES

I. Sample Holding Times: ACCEPTABLE\With the following exceptions.

Qualified Data: None

Discussion

The holding time criterion of fourteen days from date of sampling was used for soils and the product sample. The matrix spike duplicate associated with the soil samples was extracted 17 days after sampling. All other MS/MSD QC parameters (surrogates, percent recovery, and RPD values) were acceptable, so no action was taken. All analyses met the 40 days from date of extraction holding time criterion.

II. GC/MS Instrument Performance Checks: ACCEPTABLE\All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	%D or RRF	QC Criteria
Hexachlorocyclo pentadiene	UJ	9203-205-1	+74.1	Criteria limit ≤ 25%D
2,4-Dinitrophenol	UJ	9203-205-1	+66.2	Criteria limit ≤ 25%D
4-Chloroaniline	UJ	9203-205-2	+66.4	Criteria limit ≤ 25%D
Hexachlorocyclo pentadiene	UJ	9203-205-2	+67.0	Criteria limit ≤ 25%D
4-Nitroaniline	UJ	9203-205-2	+65.4	Criteria limit ≤ 25%D
4,6-Dinitro-2-Methylphenol	UJ	9203-205-2	+64.9	Criteria limit ≤ 25%D
2-Nitroaniline	R	9203-205-2	0.044	Criteria limit ≥ 0.050 RRF.

2,4-Dinitro-phenol	R	9203-205-2	0.040	Criteria limit ≥ 0.050 RRF.

Discussion

Each of the three initial calibrations had several compounds that exceeded the 30% limit for percent Relative Standard Deviation (%RSD). These compounds were not detected in any of the samples. The slightly high %RSD were judged not to affect the quantitation limits and no data qualifiers are recommended.

Each of the continuing calibrations had several compounds that exceeded the 25% limit for percent difference. While none of these compounds were detected in the samples, the high percent differences for some of the compounds demonstrated a possible loss of sensitivity for that compound, affecting the quantitation limit. These compound quantitation limits are estimated (UJ) in the associated samples, and are listed in the above table.

Two compounds in the 4/16/92 continuing calibration (3-nitroaniline and 2,4-dinitrophenol) had relative response factors (RRF) that were below the 0.05 lower acceptance threshold. There were no positive results for these compounds. The non-detects are rejected (R) due to loss of sensitivity, and are listed in the above table.

The Form 7 (continuing calibration report) submitted with the product sample data package had many errors in the "Minimum RRF" column. The RRF printed on the form did not match the RRF specified in the 3/90 SOW. Data were validated on the basis of the correct RRF from the 3/90 SOW, and all RRF results were acceptable.

The RRF for 2,4,6-tribromophenol in the soil samples was not updated. The incorrect RRF was used to calculate the detected concentration of 2,4,6-tribromophenol, which in turn invalidated all percent recoveries reported for this surrogate. As the qualifiers applied to the samples would not change on the basis of this one surrogate, no action was taken. See Section V.

IV. Blank Analyses: ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Di-n-butylphthalate Bis(2-ethylhexyl) phthalate	UJ at Reported Value	9203-205-1	Sample within 10x method blank concentration.

Bis(2-ethylhexyl) phthalate	UJ at Reported Value	9203-205-2	Sample within 10x method blank concentration.

Discussion

The method blank associated with the product sample was free of target compounds above the detection limit. Each of the soil method blanks contained di-n-butylphthalate and bis (2-ethylhexyl) phthalate. SBLKA327 also contained butylbenzylphthalate. Only the matrix spike was associated with SBLKA327, and matrix spike samples are not qualified due to blank contamination. The 'ten times' rule from Functional Guidelines was used to qualify the phthalate contamination in SBLK0324. The data qualifiers are summarized in the above table.

V. **Surrogate Recovery:** ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All positive results	J4	9201-140-1	4 surrogate recoveries above limits.
All positive results	J4	9201-140-1RE	4 surrogate recoveries above limits.
All results	R	9201-140-1A	Use results from reanalysis 9201-140-1ARE.

Discussion

For the soil samples, one analysis 9203-205-2 had a recovery for 2-fluorobiphenyl that was above the acceptance limits. All other soil surrogate recoveries were acceptable, so no soil samples were qualified due to surrogates.

For the product sample, the analysis and reanalysis at the highest concentration (5 fold dilution) each had four surrogates (2-fluorobiphenyl, terphenyl-d14, phenol-d5 and 2,4,6-tribromophenol) with percent recoveries above the acceptance limits. All positive results in those analyses are estimated (J). Functional Guidelines does not recommend qualifiers for non-detects when surrogate recoveries are high.

A 20-fold dilution and reanalysis was performed on the product sample. The dilution had three surrogates (nitrobenzene-d5, 2-fluorobiphenyl and phenol-d5) above the

acceptance limits. The reanalysis of the dilution had only phenol-d5 above the acceptance limits. The precision between the two analyses was acceptable, with the highest relative percent difference (RPD) value at 24%. For these reasons, all results from the initial 20-fold dilution are rejected (R), and the results from the reanalysis should be used.

The two additional surrogates required by the 3/90 SOW (2-chlorophenol-d4 and 1,2-dichlorobenzene-d4) were not added to the product analyses. This is a contractual violation rather than a technical one, and no data were qualified due to this problem.

Due to the software used by the laboratory most surrogate recovery results did not agree with hand calculations. This was determined to be caused by rounding performed by the software. Some of these differences resulted in surrogate recoveries being reported as acceptable when calculated results without rounding were above the control criteria. All of the 2,4,6-tribromophenol results were incorrectly calculated, as the incorrect RRF factor was used (see also Section III). Data are validated on the basis of the correct results calculated from the raw data. The laboratory was requested to submit corrected data forms.

VI. Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses: ACCEPTABLE\With the following exceptions.

Qualified Data: None.

Discussion

For the product sample, a MS/MSD set was analyzed at the high concentration (5-fold dilution) and the 20-fold dilution level. A blank spike MS/MSD was also analyzed. At the 5-fold dilution level, all percent recoveries except 2,4-dinitrotoluene in the MSD sample were above the specified control limits. In the 20-fold dilution MS/MSD, all percent recoveries were above the limits. In the blank spike MS/MSD, 11 of 22 compounds had percent recoveries above the acceptance limits. All of the RPD values were acceptable except for the RPD for phenol in the 20-fold dilution MS/MSD.

One explanation for the high recoveries is matrix effects. Other QC criteria such as surrogate and internal standard recoveries demonstrate that there is a matrix effect, especially in the 5-fold dilution. Another possible explanation is that the (on-column) level of analytes detected is 20 ug/Kg, which is the same level as the lowest calibration standard. The five point curve tends to give slightly higher variations in concentration results at the lowest (20 ug/Kg) and highest (160 ug/Kg) points in the curve. The 20 ug/Kg standard in the initial calibration also gave somewhat higher results than did the other concentrations.

In the soil samples MS/MSD set, all percent recoveries were acceptable. One RPD value (n-nitroso-di-n-propylamine at 47) was above the acceptance limit. No data are qualified on the basis of MS/MSD results alone.

VII. Field Duplicates: Not Submitted.

Discussion

A field duplicate was not submitted, but the laboratory performed the product sample analysis in duplicate. The results of the duplicates were compared. The highest RPD value was 24.6, which indicates an acceptable level of precision.

VIII. Internal Standards Performance: ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
4,6-Dinitro-2-methyl- phenol N-nitrosodiphenylamine 4-Bromophenylphenylether Hexachlorobenzene Pentachlorophenol Phenanthrene Carbazole Anthracene Di-n-butylphthalate Fluoranthene Pyrene Butylbenzylphthalate 3,3'-Dichlorobenzidine Benzo(a)anthracene bis-2-(ethylhexyl)phthalate Chrysene Di-n-octylphthalate Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	UJ(-) J4(+)	9201-140-1	Area count of IS < 50% of continuing calibration IS.

Compound	Qualifier	Sample Number	Reason
Hexachlorocyclopentadiene 2,4,6-Trichlorophenol 2,4,5-Trichlorophenol 2-Chloronaphthalene 2- Nitroaniline Dimethylphthalate Acenaphthylene 3-Nitroaniline Acenaphthene 2,4-Dinitrophenol 4-Nitrophenol Dibenzofuran 2,4-Dinitrotoluene 2,6-Dinitrotoluene Diethylphthalate 4-Chlorophenylphenylether Fluorene 4-Nitroaniline 4,6-Dinitro-2-methylphenol N-nitrosodiphenylamine 4-Bromophenylphenylether Hexachlorobenzene Pentachlorophenol Phenanthrene Carbazole Anthracene Di-n-butylphthalate Fluoranthene Pyrene Butylbenzylphthalate 3,3'-Dichlorobenzidine Benzo(a)anthracene bis-2-(ethylhexyl)phthalate Chrysene Di-n-octylphthalate Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	J4(+)/ UJ(-)	9201-140-1RE	Area count of IS < 50% of continuing calibration IS.

Discussion

For the soil samples, the internal standard (IS) areas and retention times met all the required QC criteria.

For the product analyses, all internal standard retention times were acceptable. All analyses at the 5-fold dilution level (original, reanalysis, MS, MSD) showed a matrix effect that caused the internal standard area to fall below the acceptance limit of 50% the internal standard area found in the continuing calibration standard. All compounds associated with the internal standards with low recoveries are estimated, with positive results J flagged and negative results (non-detects) UJ flagged.

IX. Compound Identification: ACCEPTABLE/All criteria met.

X. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs): ACCEPTABLE\With the following discussion.

Discussion

At least two compound quantitations per analysis were reviewed, and with the exception of 2,4,6-tribromophenol (as discussed in Section III), all reviewed compound quantitations were performed correctly and all others are assumed to be correct.

The CLP SOW requires that semi-volatile compounds use a CRQL base of 10 ppb for most compounds and 50 ppb for eight compounds for quantitation limit calculations. These numbers are adjusted to reflect sample matrix, size, moisture factors and dilutions. All CRQL calculations in the reviewed data packages assume a base of 10 ppb and 25 ppb. As there were no positive results for the compounds with incorrect CRQL, and as the reported CRQL are lower than the CLP CRQL, no action was taken. All CRQL were correctly adjusted for sample size, dilution factors and moisture correction factors.

XI. Tentatively Identified Compounds (TIC): ACCEPTABLE\With the following exceptions.

Qualified Data:

Sample Number	Retention Time	Compound Identification	Corrected Compound Identification	C.A.S.
9203-112-1	15.72	Unknown Hydrocarbon	1H-Indene, 2,3-dihydro-1-methyl (or isomer)	767588
9203-112-1	18.35	Unknown Hydrocarbon	Unknown aromatic	--
9203-112-1	20.50	Unknown Hydrocarbon	Naphthalene, 1-ethyl-	1127760

9203-112-1	21.32	Unknown Hydrocarbon	Naphthalene, 1,4-dimethyl (or isomer)	571584
9203-112-1	23.17	Unknown Hydrocarbon	Naphthalene, 2,3,6-trimethyl (or isomer)	829265

Discussion

The results of mass spectral library searches to identify TIC were reviewed. With the exception of the above noted compounds for sample 9203-112-1, all TIC results are acceptable. The above noted changes give more specific identifications for generically identified TIC. It should also be noted that any reported compound that exists in several possible forms (such as 1,7-dimethyl naphthalene and 1,2-dimethyl naphthalene) should always be identified with the proviso "or isomer" unless the isomer specific retention times are known.

XII. System Performance: ACCEPTABLE\All criteria met.

XIII. Overall Assessment of the Data:

Most of the qualifiers applied to the product analyses are due to matrix effects, as demonstrated by the reanalyses and the subsequent dilutions and reanalyses. The most accurate results are from the reanalysis of the 20-fold dilution. The data from the five-fold dilution are best used to set lower detection limits. With a few exceptions due to calibration drift (as summarized in the table in Section III), the soil analyses are acceptable as reported by the lab.

DATA VALIDATION REPORT
PESTICIDE/PCB ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Instrument Performance:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Several compounds failed to elute within their established retention time windows for some of the continuing calibration standards. Adjusted/expanded RT windows were employed to ensure that no false identifications were made. None were found and no qualifications of data are recommended.

III. **Calibration:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Several compounds failed to meet continuing calibration criteria. No out-of-control standards were used for quantitation and no qualifications of data are recommended.

IV. **Blank Analyses:** ACCEPTABLE/All criteria met.

V. **Surrogate Recovery:** ACCEPTABLE/All criteria met.

VI. **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Gamma-BHC Aldrin Endrin	UJ	9201-140-1	Low MS/MSD recoveries. (28-40%)

Discussion

MS/MSD recoveries were low for three spiked compounds. Results for these three compounds have been qualified as estimated as shown in the table above.

VII. Field Duplicates: Not Submitted.

Discussion

A field duplicate was not submitted, but the laboratory performed the product sample analysis in duplicate. No pesticides or PCBs were detected in either analyses.

VIII. Compound Identification: ACCEPTABLE/All criteria met.

IX. Compound Quantitation and Contract Required Quantitation Limits (CRQLs): ACCEPTABLE/All criteria met.

X. Overall Assessment of the Data

Generally, the laboratory performed the pesticide/PCB analysis within contract specifications. A few problems were found and have been noted in this report. The data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
POLYNUCLEAR AROMATIC HYDROCARBON ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Instrument Performance:** ACCEPTABLE/All criteria met.

III. **Calibration:** ACCEPTABLE/All criteria met.

IV. **Blank Analyses:** ACCEPTABLE/All criteria met.

V. **Surrogate Recovery:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The surrogate recovery (410%) for the product sample was outside of QC limits (31-141%) due to matrix interferences. No qualifications of data are recommended.

VI. **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The complexity of the matrix for this sample necessitated a 1:100 dilution. At this dilution all spiked compounds should have been diluted out. All percent recoveries of all spiked compounds were outside of QC limits (4-149%). Interferences in the matrix undoubtedly led to these problems and no qualifications of data are recommended.

VII. **Field Duplicates:** Not Submitted.

Discussion

A field duplicate was not submitted, but the laboratory performed the product sample

analysis in duplicate. The results of the duplicates were compared. The highest RPD value was 31.6%, which indicates an acceptable level of precision.

VIII. Compound Identification: ACCEPTABLE/All criteria met.

IX. Compound Quantitation and Contract Required Quantitation Limits (CRQLs): ACCEPTABLE/All criteria met.

X. Overall Assessment of the Data

The laboratory performed the PAH analysis within contract specifications. The data, as reported, are acceptable for use.

DATA VALIDATION REPORT
TOTAL METALS ANALYSES

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Discussion

The samples were all analyzed within the water recommended holding time, except samples S22813 and S22814 for mercury. The two samples were analyzed one to two days outside the recommended holding time for water. Because sample analysis only exceeded the water recommended holding time by 1 - 2 days, and no holding time criterion has been established for soils, no data qualifiers are recommended.

II. Instrument Calibration: ACCEPTABLE/All criteria met.

Discussion

All Initial and Continuing Calibration Verification (ICV and CCV) standards used for sample determinations were within the control limits for all samples.

III. Blanks: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Aluminum	UJ	S20825, S20825D	Sample results within five times the blank concentration.
Barium	UJ	S20825	Sample results within five times the blank concentration.
Iron	UJ	S20825, S20825D	Sample results within five times the blank concentration.
Magnesium	UJ	S20825	Sample results within five times the blank concentration.
Potassium	UJ(-) J4(+)	S22813, S22814, S22815	Negative blank results reported. The possibility of false negative or biased low sample results exists.
Sodium	UJ	S20825	Sample results within five times the blank concentration.

Zinc	UJ	S20825, S20825D	Sample results within five times the blank concentration.

Discussion

Two types of blanks were evaluated for possible contamination affects. These blanks are: calibration blanks (CCB) and preparation blanks (PB).

For all laboratory blanks, both positive and negative blank values are evaluated, and an action limit of five times the highest associated blank concentration is determined for each affected analyte. For analytes with positive blank values, if the sample result was less than the action limit, it should be considered undetected at the reported concentration and assigned a UJ qualifier. No data qualifiers are required for undetected sample results. For analytes with negative blank values, the raw data were reviewed, and each sample raw data result was checked to see if a possible false negative or biased sample result was reported. Samples to be qualified, based on this review, are summarized in the above table.

IV. **ICP Interference Check Sample (ICS) Analysis:** ACCEPTABLE/All criteria met.

V. **Laboratory Control Sample (LCS) Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data: None.

Discussion

The laboratory analyzed a soil standard as the LCS with the product sample. The matrices are not comparable. However, no standard is available that would match the product sample.

VI. **Duplicate Sample Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data: None.

Discussion

The duplicate results were within the control limits for all analytes. Chromium was flagged by the laboratory as being outside the control limits for JOB303. The relative percent difference (RPD) for chromium was 26.1%. The laboratory is required to flag any analytes with a RPD greater than 20%. Under the 1988 Inorganics Functional Guidelines,

soil sample duplicate results are acceptable if the RPD is less than 35% or results less than two times the CRDL. Therefore, no data qualifiers are recommended.

VII. Spiked Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Arsenic	UJ(-) J4(+)	S22813, S22814, S22815	The percent recovery of the MS was 66%.
Arsenic	R	S20825, S20825D	The percent recovery of the MS was 14%.
Lead	J4	S20825, S20825D	The percent recovery of the MS was 334%.
Lead	UJ(-) J4(+)	S22813, S22814, S22815	The percent recovery of the MS was 60%.
Selenium	J4	S20825	The percent recovery of the MS was 348%.
Selenium	UJ(-) J4(+)	S22813, S22814, S22815	The percent recovery of the MS was 73%.

Discussion

All matrix spike (MS) percent recoveries were within the control limits, except arsenic, lead, and selenium for both SDG. Sample qualifications were determined following the guidelines specified in the 1988 Inorganics Functional Guidelines. Samples to be qualified are summarized in the above table.

The laboratory analyzed additional QC samples with JOB048. The laboratory analyzed a blank spike and a blank spike duplicate. The RPD between the blank spikes was calculated and all analytes had a RPD less than 20%. The percent recovery for the blank spikes was not calculated and true values were not included in the data package. Duplicate instrument analysis was performed on the matrix spike. The RPD between MS duplicate analyses for all analytes ranged from 5.1 - 22.0%.

VIII. Furnace AA Quality Control Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Lead	UJ(-) J4(+)	S20825, S20825D	Analytical spikes were not performed.
Selenium	UJ(-) J4(+)	S20825, S20825D	Analytical spikes were not performed.
Thallium	UJ(-) J4(+)	S20825, S20825D	Analytical spikes were not performed.

Discussion

The laboratory is required to perform an analytical spike on each analyte analyzed by graphite furnace (GFA). The percent recovery control limits of the analytical spike is 85 - 115%. If sample analytical spike recoveries fall outside the control limits, matrix interferences (positive or negative) may be present. If the sample result is less than 50% of the analytical spike concentration and the percent recovery is greater than 40%, no further action is required by the laboratory, but the laboratory must flag the data with a W. The laboratory correctly flagged all samples associated with JOB303. The laboratory did not analyze analytical spikes with JOB048. Arsenic was analyzed by methods of standard additions. Lead, selenium, and thallium were analyzed directly on the graphite furnace, requiring the analysis of an analytical spike. It is recommended that the sample associated with JOB048 be qualified for lead, selenium, and thallium because matrix interferences may be present.

If the sample absorbance is greater than 50% of the analytical spike concentration and the percent recovery is outside the control limits, the laboratory is required to analyze the sample by methods of standard additions (MSA). The laboratory did perform the MSA analyses where required. All samples analyzed by MSA had correlation coefficients within the control limits (>0.995).

The 1988 Inorganic Functional Guidelines specifies that samples with analytical spike recoveries outside the control limits (85-115%) are to be qualified as estimates. However, review of the date indicated that no sample, where the post spike recovery was outside the control limits, had results detected above the CRDL. It is recommended that only those samples with analyte concentrations greater than the CRDL be qualified.

Samples Requiring the W Qualifier			
Arsenic	Lead	Selenium	Thallium
S22815	S22813 S22814	None	None

IX. ICP Serial Dilution Analysis: ACCEPTABLE/All criteria met.

X. Sample Result Verification: ACCEPTABLE/With the following exceptions.

Qualified Data: None.

Discussion

QC sample results and sample results were verified at a frequency of ten percent. No data calculation errors were found.

For Sample S22814, the laboratory did not list the N qualifier for arsenic. The laboratory was contacted and a corrected Form 1 was submitted.

XI. Field Quality Controls: Not Applicable.

XII. Quarterly Submissions: ACCEPTABLE/All criteria met.

XIII. Overall Assessment of Data

The overall quality of the data packages was good. Samples were qualified for blank contamination, and matrix spike results. The laboratory performed all required QC checks for both SDG. For JOB048, the laboratory analyzed additional QC checks (Blank spikes and analyzed the MS in duplicate). However, the matrix of the product sample submitted in JOB048 made analysis difficult, and all results for that sample suspect. Sample qualifications were made based solely on the results of the QC checks analyzed. It should be noted that the QC samples available to the laboratory may not reflect the problems associated with this sample due to the matrix interferences.

Groundwater Validation Report

EcoChem, Inc.

DATA VALIDATION REPORT

Amsted Groundwater Investigation

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July 7, 1992
Final

Amsted Groundwater Investigation

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INTRODUCTION

The submitted data packages have been reviewed by EcoChem, Inc. Data validation packets for the organics and inorganics analyses, which detail items reviewed, are on file at EcoChem. The quality assurance evaluations performed and the resulting data qualification recommendations are summarized in the following sections:

- Volatile Organic Analyses
- Semivolatile Analyses
- Pesticide/PCB Analyses
- Polynuclear Aromatic Hydrocarbon Analyses
- Total Metals, Low-level Copper, Boron and Cyanide Analyses
- Total Petroleum Hydrocarbon Analyses
- Total Dissolved Solids and Total Suspended Solids Analyses

Recommended data qualifiers are based on the EPA Data Validation Functional Guidelines (U.S. EPA, 1988b,c,d). These guidelines require that the data reviewer use professional judgment to designate data qualifiers, but do not replace those assigned by the laboratory. Data may be qualified even though the laboratory fulfilled all the requirements stated in the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for a particular analysis (U.S. EPA, 1988a, 1990a,b). Unless specifically stated in the text, data qualifications are not due to laboratory error or deviations from the analysis protocols defined in the EPA SOW, but are based on EPA data validation guidelines.

EcoChem, Inc.'s goal in assigning data validation qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data can be used for site evaluation purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet all data quality goals as outlined in the EPA Functional Guidelines and as required by the South Tacoma Field Superfund Site Quality Assurance Project Plan, March, 1991.

Holding times, sample integrity and required analyses were determined by review of the chain-of-custody sheets. Chain-of-custody records were received for all samples. A summary of the samples reviewed is provided in Table 1.

Table 1. Amsted Groundwater Investigation Sample Index

KJC Sample ID	VOA	SV	P/PCB	PAH	Metals+B+CN	TPH	TSS/TDS
1773GU000000027.000	X	X	X	X	X	X	X
1775GU000000025.000	X	X	X	X	X	X	X
1789GU201000042.000	X	X	X	X	X	X	X
1790GU310000042.000	X	X	X	X	X	X	X
1791GU310000041.000	X	X	X	X	X	X	X
1792GU000000042.000	X	X	X	X	X	X	X
1793GU000000042.000	X	X	X	X	X	X	X
1795GU310000042.000	X	X	X	X	X	X	X
2000GU202000042.000	X	X	X	X	X	X	X
3730WW000002000.000	X	X	X	X	X	X	X
3739WW000003000.000	X						

Key:

VOA = Volatile Organic Compounds

SV = Semivolatile Organic Compounds

P/PCB = TCL Pesticides and Polychlorinated Biphenyls

PAH = Polynuclear Aromatic Hydrocarbons

Metals = TCL Metals and Low-level Copper

B = Boron

CN = Cyanide

TPH = Total Petroleum Hydrocarbons

TSS/TDS = Total Suspended/Dissolved Solids

REFERENCES

Kennedy/Jenks/Chilton. 1991. Quality Assurance Project Plan South Tacoma Field Superfund Site, Tacoma, Wa. March.

U.S. Environmental Protection Agency. 1988a. Contract Laboratory Program Statement of Work for Pesticides/PCBs.

U.S. Environmental Protection Agency. 1988b. Functional Guidelines for Evaluating Inorganic Analyses.

U.S. Environmental Protection Agency. 1988c. Functional Guidelines for Evaluating Organic Analyses. R-582-5-5-01.

U.S. Environmental Protection Agency. 1988d. Functional Guidelines for Evaluating Pesticide/PCB Analyses. R-582-5-5-01.

U.S. Environmental Protection Agency. 1990a. Contract Laboratory Program Statements of Work for Inorganics. ILM01.0.

U.S. Environmental Protection Agency. 1990b. Contract Laboratory Program Statements of Work for Organics. OLM01.0.

NARRATIVE

DATA VALIDATION REPORT
VOLATILE ORGANIC ANALYSES

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All Volatile Compounds	J3(+)/UJ(-)	9205-049-7RE 9205-049-8RE	Holding times exceeded.

Discussion

Samples 9205-049-7RE and 9205-049-8RE were analyzed to prove carry-over contamination in the initial results (see Section X). However, the samples were analyzed outside the holding time criterion of 14 days (for preserved water samples) by three days. Functional Guidelines recommends that if holding times are exceeded, any detected compounds are qualified as estimated (J3) and sample quantitation limits are estimated (UJ). All other samples were analyzed within the recommended holding time. Qualified data are summarized above.

II. GC/MS Instrument Performance Check: ACCEPTABLE/All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Acetone	J4(+)/UJ(-)	9205-049-1, 9205-049-2, 9205-049-3, 9205-049-4, 9205-049-5, 9205-049-6, 9205-049-7, 9205-049-8, 9205-049-9, 9205-049-10, 9205-049-11	Initial calibration %RSD >30%. %RSD=54.6%
Acetone	UJ(-)	9205-049-7RE, 9205-049-8RE	Continuing calibration %D >50%. %D= 62.8%
2-Butanone	UJ(-)	9205-049-7RE, 9205-049-8RE	Continuing calibration %D >50%. %D = 66.2%
2-Hexanone	UJ(-)	9205-049-7RE, 9205-049-8RE	Continuing calibration %D >50%. %D = 63.0%

Discussion

The relative response factor (RRF) and the relative standard deviation (%RSD) for the initial calibration and the RRF and percent difference (%D) for the continuing calibration were evaluated. Criteria for %D and %RSD between calibrations were not met for compounds listed above. As stated in Functional Guidelines, positive results are estimated (J4), if initial calibration %RSD is greater than 30% and if %D for continuing calibration is greater than 25%. For significant %RSD or %D variations (>50%), detection limits are also qualified (UJ). Qualifiers are summarized in the above table.

IV. **Blank Analyses:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Methylene Chloride	UJ	9205-049-7, 9205-049-11, 9205-049-8RE	Sample concentration <10 times method blank concentration.
Hexane	R	9205-049-1, 9205-049-2, 9205-049-3, 9205-049-4, 9205-049-5, 9205-049-6, 9205-049-7, 9205-049-8, 9205-049-9, 9205-049-10, 9205-049-11	TIC found in the method blank and associated samples.

Discussion

Methylene chloride, acetone and hexane were detected in the laboratory method blanks. Because methylene chloride and acetone are common laboratory contaminants, an action level is determined for data qualification at ten times the highest associated blank value. Because hexane is a tentatively identified compound (TIC), any detection in the associated samples are rejected (R). Qualified data are listed above.

A trip (Sample 9205-049-4) and rinsate (Sample 9205-049-9) blank were submitted for review. Hexane was detected in both the trip and rinsate blanks. Because hexane (a TIC) was found in the associated method blanks and hexane results are rejected in the associated samples, no qualifiers are required based on field blanks. Toluene was detected in the rinsate blank. Because no toluene was detected in the associated samples, no data are qualified.

V. **Surrogate Recovery:** ACCEPTABLE/All criteria met.

VI. **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses:** ACCEPTABLE/All criteria met.

VII. **Field Duplicates:** ACCEPTABLE/With the following discussion.

Discussion

One set of field duplicates, Samples 9205-049-2/9205-049-3, were submitted for volatile analysis. Chloroform was detected in both samples at the same concentration resulting in a 0% Relative Percent Difference (RPD), indicating good field replication.

VIII. **Internal Standards Performance:** ACCEPTABLE/All criteria met.

IX. **Compound Identification:** ACCEPTABLE/All criteria met.

X. **Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):** ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All Volatile Compounds	R	9205-049-7RE, 9205-049-8RE	Analyzed to support carry-over contamination claim. Use initial results.

Discussion

The laboratory's case narrative states that there was possible carry-over contamination from previous analyses to Samples 9205-049-7 and 9205-049-8. Reanalysis was performed (outside recommended holding time criteria) resulting in no carry-over compounds detected. Because the reanalyses were analyzed to confirm a carry-over contamination problem, initial analysis results are accepted and reanalysis results are rejected. The compounds were carry-over contamination and not in the sample, the contaminants were not reported on the initial analysis Form I. Qualified data are summarized above.

XI. Tentatively Identified Compounds (TIC): ACCEPTABLE/With the following discussion.

Discussion

All TIC results are flagged as tentatively identified compounds with estimated concentrations (JN).

XII. System Performance: ACCEPTABLE/All criteria met.

XIII. Overall Assessment of the Data

The data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
SEMIVOLATILE ORGANICS ANALYSES

I. Sample Holding Times: ACCEPTABLE\All criteria met.

II. GC/MS Instrument Performance Checks: ACCEPTABLE\All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	%D	QC Criteria
Hexachlorocyclo pentadiene	UJ	9205-049-1, 9205-049-2, 9205-049-3, 9205-049-6, 9205-049-7	+ 57.8%	Criteria limit ≤ 25% D

Discussion

All of the relative response factors (RRF) were acceptable for all calibrations. All of the percent relative standard deviation (%RSD) in the initial calibration were below the control limit of 30% RSD. Several compounds in each of the continuing calibrations had percent difference (%D) values above the 25% upper control limit. There were no positive results for any of these compounds. For %D values that are high (above +50%) there is a possible loss of instrument sensitivity, affecting the quantitation limit. One compound had a %D value above 50% and is qualified as summarized in the above table.

IV. Blank Analyses: ACCEPTABLE\With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
TIC at RT= 6.50 TIC at RT= 8.97 TIC at RT=13.60 TIC at RT=14.22 TIC at RT=20.14	R	All samples	TIC detected in blank

Discussion

The method blank associated with these samples was free of target compounds above the detection limit. Several unknown compounds were detected in the blank. As these compounds are present in the method blank and in all samples, the compounds are probably the result of laboratory contamination. For this reason, any unknown compound detected in a sample that is also present in the method blank is rejected (R).

V. **Surrogate Recovery:** ACCEPTABLE\With the following discussion.

Discussion

Most of the reported surrogate recoveries did not agree with hand calculated results. The software used by the laboratory incorrectly used the sample volume when calculating surrogate recoveries. As the difference between the reported results and the true results is minor, no action was taken.

Several surrogates were reported that are outside the control limits. The hand calculated recoveries are acceptable. No qualifiers are required.

VI. **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses:** ACCEPTABLE\With the following exceptions.

Qualified Data: None

Discussion

Analysis of MS/MSD samples was performed at the frequency of one set per twenty (or less) samples. All of the relative percent difference (RPD) values were within the specified control limits.

As discussed in Section V, the software used to generate the forms did not calculate the spike recoveries correctly. The sample volume was improperly used during the percent recovery calculations. All results were recalculated. The following compounds had percent recoveries above the specified control limits in both the MS and MSD samples: 4-nitrophenol, 2,4-dinitrotoluene and pentachlorophenol. There were no positive results for these compound in any of the samples. No data are qualified on the basis of MS/MSD results alone.

VII. **Field Duplicates:** ACCEPTABLE\All criteria met.

VIII. Internal Standards Performance: ACCEPTABLE\All criteria met.

IX. Compound Identification: ACCEPTABLE\All criteria met.

X. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL): ACCEPTABLE\With the following discussion.

Discussion

At least two compound or surrogate quantitations per analysis were reviewed, and all reviewed compound quantitations were performed correctly, and all others are assumed to be correct.

The CLP SOW requires that semi-volatile compounds use a CRQL base of 10 ppb for most compounds and 50 ppb for eight compounds for quantitation limit calculations. These numbers are adjusted to reflect sample matrix, size, moisture factors and dilutions. All CRQL calculations in the data package assume a base of 10 ppb and 25 ppb. As there were no positive results for the compounds with the incorrect CRQL, and as the reported CRQL is lower than the CLP CRQL, no action was taken. All CRQL were adjusted correctly for sample size and dilution factors.

XI. Tentatively Identified Compounds (TIC): ACCEPTABLE\With the following discussion.

Discussion

The results of mass spectral library searches to identify TIC were reviewed. As discussed in Section IV, any TIC in a sample that was also detected in the method blank is assumed to be the result of laboratory contamination and is rejected. All other TIC results are acceptable.

XII. System Performance: ACCEPTABLE\All criteria met.

XIII. Overall Assessment of the Data

Data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
PESTICIDE/PCB ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Instrument Performance: ACCEPTABLE/All criteria met.

III. Calibration: ACCEPTABLE/With the following discussion.

Discussion

The percent relative standard deviation (%RSD) for dibutylchlorendate (DBC) for the DB-1701 (confirmation) column was 10.6%. The 10.0% RSD criterion is not required to be met for the confirmation column and no action was required.

One calibration factor for aldrin was transcribed incorrectly as 2610000 on Form VIII PEST-1 for the DB-1701 column. The correct value was 3610000. The %RSD value reported, 8.4%, was correct. No qualifications of data are recommended based on calibration information.

IV. Blank Analyses: ACCEPTABLE/All criteria met.

V. Surrogate Recovery: ACCEPTABLE/All criteria met.

VI. Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses: ACCEPTABLE/All criteria met.

VII. Field Duplicates: ACCEPTABLE/All criteria met.

One pair of field duplicates was submitted. No positive identifications were made in either sample.

VIII. Compound Identification: ACCEPTABLE/All criteria met.

IX. Compound Quantitation and Contract Required Quantitation Limits (CRQL): ACCEPTABLE/All criteria met.

X. Overall Assessment of the Data

The laboratory performed the pesticide/PCB analyses within method specifications. All contract criteria were met. The data, as reported, are acceptable for use.

DATA VALIDATION REPORT
POLYNUCLEAR AROMATIC HYDROCARBON ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Instrument Performance: ACCEPTABLE/All criteria met.

III. Calibration: ACCEPTABLE/With the following discussion.

Discussion

Several compounds failed to meet the 15.0% QC limit for continuing calibration for the primary analysis. Exceeded values ranged from 16-18%. No compounds were positively identified in any samples associated with this data group. No qualifications of data are recommended based on calibration information.

IV. Blank Analyses: ACCEPTABLE/All criteria met.

V. Surrogate Recovery: ACCEPTABLE/All criteria met.

VI. Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses: ACCEPTABLE/All criteria met.

VII. Field Duplicates: ACCEPTABLE/All criteria met.

One pair of field duplicates was submitted. No positive identifications were made in either sample.

VIII. Compound Identification: ACCEPTABLE/All criteria met.

IX. Compound Quantitation and Contract Required Quantitation Limits (CRQL): ACCEPTABLE/All criteria met.

X. Overall Assessment of the Data

Generally, the laboratory performed the PAH analyses within method specifications. Those problems found have been noted in this report. The data, as reported, are acceptable for use.

DATA VALIDATION REPORT
TOTAL METALS, LOW LEVEL COPPER, BORON AND CYANIDE ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Instrument Calibration:** ACCEPTABLE/All criteria met.

III. **Blank Analyses:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Boron	UJ	W24336, W24339, W24340	The sample concentration was within five times the PB concentration.
Cadmium	UJ	W24339, W24341	The sample concentration was within five times the PB concentration.
Zinc	UJ	W24337, W24339, W24340, W24341, W24342, W24344	The sample concentration was within five times the PB concentration.

Discussion

Three types of blanks are evaluated for possible contamination affects. These blanks are: calibration blanks (ICB and CCB), preparation blanks (PB), and field QC blanks.

For all laboratory blanks, both positive and negative blank values were evaluated, and an action limit of five times the highest associated blank concentration was determined for each affected analyte. For analytes with positive blank values, if the sample result was less than the action limit, it should be considered undetected at the reported concentration and assigned a UJ qualifier. No data qualifiers are required for undetected sample results. For analytes with negative blank values, the raw data were reviewed, and each sample raw data result was checked to see if a possible false negative or biased sample result was reported. Samples to be qualified, based on this review, are summarized in the above table.

One field blank was submitted for analysis. Boron, cadmium, lead, sodium, and zinc were found in the field blank. Zinc was detected at a concentration greater than the CRDL. No data qualification of the samples will be made based on the field blank results. However, consideration of the field blank contamination above the CRDL should be made when evaluating the data.

Other analytes may have reported positive or negative blanks for the ICB, CCB, PB, and field QC blanks but either the sample results were undetected, greater than the action limit, or upon review of the raw data, were not affected by the associated blank value.

IV. ICP Interference Check Sample (ICS) Analyses: ACCEPTABLE/All criteria met.

V. Laboratory Control Sample (LCS) Analyses: ACCEPTABLE/All criteria met.

VI. Duplicate Sample Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Iron	UJ(-) J4(+)	W24336, W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344, W24345	The RPD (21.2%) between duplicate sample results was outside the control limits (RPD < 20%, or ± CRDL).
Zinc	UJ(-) J4(+)	W24336, W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344, W24345	The RPD (92.9%) between duplicate sample results was outside the control limits (RPD < 20%, or ± CRDL).

Discussion

The duplicate results for all analytes, except iron and zinc, were within the water control limits. For water duplicate results, the relative percent difference (RPD) must be less than 20%, or the duplicate results must agree within ± CRDL. The laboratory flagged calcium and sodium as outside the control limits. The RPD for both analytes were 0.7%. No data qualifications are required for calcium and sodium. Samples to be qualified are summarized in the above table.

VII. Spiked Sample Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Lead	J4(+)	W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344, W24345	The percent recovery of the MS was greater than 125% (133%).
Selenium	UJ(-) J4(+)	W24336, W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344, W24345	The percent recovery of the MS was between 30 - 74% (70%).

Discussion

Matrix spike (MS) percent recoveries were within the control limits, except MS recoveries for lead and selenium. Sample qualifications were determined following the guidelines specified in the 1988 Inorganics Functional Guidelines. Samples to be qualified are summarized in the above table.

VIII. Furnace AA Quality Control Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Copper	J4	W24338, W24339, W24340, W24341, W24342, W24344	The post spike percent recoveries were less than 85% (69% - 79%).
Lead	J4	W24338, W24341, W24343, W24344	The post spike percent recoveries were greater than 115% (134% - 196%).

Discussion

The laboratory is required to perform a post digestion spike on each analyte analyzed by graphite furnace (GFA). The percent recovery control limits of the post spike is 85 - 115%. If sample post spike recoveries fall outside the control limits, matrix interferences (positive or negative) may be present. If the sample result is less than 50% of the post spike concentration and the percent recovery is greater than 40%, no further action is required by the laboratory, but the laboratory must flag the data with a W. The W flag is required for all samples summarized in the table below.

If the sample absorbance is greater than 50% of the post spike concentration and the percent recovery is outside the control limits, the laboratory is required to analyze the sample by methods of standard additions (MSA). The laboratory did perform the MSA analyses when required. All samples analyzed by MSA had correlation coefficients within the control limit (>0.995).

Under the 1988 Inorganic Functional Guidelines, samples with post spike recoveries outside the control limits (85-115%) are to be qualified as estimates. However, review of the date indicated that no sample, where the post spike recovery was outside the control limits, had results detected above the CRDL, except six samples for copper (CRDL = 1.0 ug/L) and four samples for lead (CRDL = 3.0 ug/L). It is recommended that only those samples with analyte concentrations greater than the CRDL be qualified. Therefore, data qualifiers are recommended for the copper and lead results summarized in the above table.

Samples Requiring the W Qualifier				
Arsenic	**Copper**	**Lead**	**Selenium**	**Thallium**
None	W24337, W24338, W24339, W24340, W24341, W24342, W24344	W24336, W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344	W24336, W24337, W24338, W24339, W24340, W24341, W24342, W24343, W24344, W24345	None

IX. ICP Serial Dilution Analyses: ACCEPTABLE/All criteria met.

X. Sample Result Verification: ACCEPTABLE/With the following discussion.

Discussion

The sample and QC results were verified at a minimum of ten percent. No data calculation errors were found.

The following transcription errors were noted:

(1) A lab sample identification number was entered incorrectly for sample 1773GU000000027.000. The correct lab sample ID number should be W24336.

(2) Undetected duplicate results were entered on Form 6 (Duplicates) as undetected at a concentration less than the IDL.

(3) The calcium and sodium results erroneously were qualified based on duplicate results. Review of the raw data indicated the results reported were correct, and the RPD values reported were 0.7% for both calcium and sodium.

The laboratory was contacted and corrected forms were submitted.

XI. Field Quality Controls: ACCEPTABLE/With the following discussion.

Discussion

One field duplicate sample was submitted to the laboratory for analysis. All analyte duplicate results were within the control limits (RPD < 20%, or ± CRDL), except zinc (RPD = 129%). Zinc results have been previously qualified due to laboratory duplicate results.

XII. Quarterly Submissions: ACCEPTABLE/All criteria met.

XIII. Overall Assessment of Data:

The overall data quality was good. Samples were qualified for blank contamination, duplicate and matrix spike results. Zinc was detected in the field blank at a concentration greater than the CRDL. The laboratory field duplicate results for zinc also exceeded the control limits. This may be a result of introduction of zinc during field or laboratory procedures.

DATA VALIDATION REPORT
TOTAL PETROLEUM HYDROCARBON ANALYSIS

I. Sample Holding Times: ACCEPTABLE/All criteria met.

Samples were analyzed within the recommended holding time of 28 days.

II. Instrument Calibration: ACCEPTABLE/All criteria met.

The instrument was calibrated using a blank and four standards as described in the method.

III. Blank Analyses: ACCEPTABLE/All criteria met.

No contamination was found in the blanks.

IV. Laboratory Control Sample: ACCEPTABLE/All criteria met.

The laboratory analyzed a blank spike and a blank spike duplicate. The percent recoveries were 65% and 66%, with an RPD of 2%.

V. Duplicate Sample Analyses: ACCEPTABLE/All criteria met.

The laboratory analyzed one duplicate sample. The duplicate analyses were both undetected for TPH, therefore the RPD was not calculated.

VI. Spike Sample Analyses: ACCEPTABLE/All criteria met.

The laboratory analyzed one matrix spike and a matrix spike duplicate. The percent recoveries were 77% and 80%, with an RPD of 4%.

VII. Sample Result Verification: ACCEPTABLE/All criteria met.

VIII. Field Quality Controls: ACCEPTABLE/All criteria met.

One field duplicate sample was submitted for analysis. Both samples were undetected for TPH, therefore the RPD was not calculated.

IX. Overall Assessment of Data:

The overall data quality was good. The percent recoveries of the blank spikes were slightly low but because the matrix spike results were good, no data were qualified.

DATA VALIDATION REPORT
TOTAL DISSOLVED SOLIDS (TDS) AND
TOTAL SUSPENDED SOLIDS (TSS) ANALYSIS

I. Sample Holding Times: ACCEPTABLE/All criteria met.

Samples were analyzed within the recommended holding time of 7 days.

II. Blank Analyses: ACCEPTABLE/With the following discussion.

Discussion

No contamination was found in the blank associated with the TSS. Blank contamination was found in the TDS blank at the method detection limit. All sample results, except the field blank, had TDS concentrations greater than ten times the blank concentration. No data qualifications are recommended.

No contamination was found in the field blank for TSS. The field blank had a TDS concentration of 27 mg/L. No data qualifications are recommended based on the field blank, but should be considered when interpreting TDS results.

III. Laboratory Control Sample: Not Applicable.

No laboratory control sample was analyzed with the samples.

IV. Duplicate Sample Analyses: ACCEPTABLE/All criteria met.

The laboratory analyzed one duplicate sample for TDS and TSS. The relative percent difference (RPD) between TDS results was zero, and RPD was not calculated for TSS due to undetected sample results for TSS.

V. Spike Sample Analyses: Not Applicable.

VI. Sample Result Verification: ACCEPTABLE/All criteria met.

VII. Field Quality Controls: ACCEPTABLE/All criteria met.

One field duplicate sample was submitted for analysis. For the TDS analysis the RPD was 12.5%, and for the TSS analysis the RPD was 5.4%, indicating good precision.

VIII. Overall Assessment of Data:

The data quality was good. No data were qualified.

Groundwater Validation Report

(Well NMW-13 Sampled 18 September 1992)

EcoChem, Inc.

Environmental Science and Chemistry

DATA VALIDATION REPORT

Amsted Groundwater Investigation

Prepared for:

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EcoChem Contract: C2308-1

November 24, 1992
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Amsted Groundwater Investigation

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INTRODUCTION

Basis for the Data Validation

The submitted data packages have been reviewed by EcoChem, Inc. Data validation packets for the organics analyses, which detail items reviewed, are on file at EcoChem. The quality assurance evaluations performed and the resulting data qualification recommendations are summarized in the following sections:

- Volatile Organic Analyses
- Semivolatile Analyses
- Polynuclear Aromatic Hydrocarbon Analyses
- Total Petroleum Hydrocarbon Analyses

Recommended data qualifiers are based on the EPA Data Validation Functional Guidelines (U.S. EPA, 1988). These guidelines require that the data reviewer use professional judgment to designate data qualifiers, but do not replace those assigned by the laboratory. Data may be qualified even though the laboratory fulfilled all the requirements stated in the required methods (U.S. EPA, 1986, and WDOE, 1991). Unless specifically stated in the text, data qualifications are not due to laboratory error or deviations from the analysis protocols specified in the methods, but are based on EPA data validation guidelines.

EcoChem, Inc.'s goal in assigning data validation qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data can be used for site evaluation purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet all data quality goals as outlined in the EPA Functional Guidelines and as required by the South Tacoma Field Superfund Site Quality Assurance Project Plan, March, 1991.

Holding times, sample integrity and required analyses were determined by review of the chain-of-custody sheets. Chain-of-custody records were received for all samples. A summary of the samples reviewed is provided in Table 1.

Table 1. Amsted Groundwater Investigation Sample Index

KJC Sample ID	VOA	SV	PAH	TPH
NMW-13A	X	X	X	X
NMW-15A	X	X	X	X

Key:

VOA = Volatile Organic Compounds

SV = Semivolatile Organic Compounds

PAH = Polynuclear Aromatic Hydrocarbons

TPH = Total Petroleum Hydrocarbons

NARRATIVE

DATA VALIDATION REPORT
VOLATILE ORGANIC ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. GC/MS Instrument Performance Check: ACCEPTABLE/All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	QC Value	QC Criteria
2-Butanone	J	NMW-13A	%D = +35.5%	%D ≤ 25%

Discussion

The relative response factor (RRF) and the relative standard deviation (%RSD) for the initial calibration were evaluated and all criteria were met. Both of the continuing calibration standards had compounds with a percent difference (%D) between initial and continuing calibration RRF that exceeded the upper limit of 25 percent. For compounds not detected in the associated samples, no action was taken. All positively identified compounds were qualified J as estimated. Sample NMW-15A also had a positive identification for 2-butanone, but since this compound was already qualified U for blank contamination, the additional J qualifier was not assigned. Qualified data are summarized in the table above.

IV. Blank Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Blank Value	Action Level
2-Butanone	U at Reported Concentration	NMW-15A	11 µg/L	110 µg/L

Discussion

Methylene chloride and 2-butanone were detected in one of the laboratory method blanks. Because methylene chloride was not detected in the associated sample, no qualifiers were

assigned for this compound. 2-Butanone was detected in the associated sample, and the reported concentration did not exceed the action level of 10 times the blank concentration. This compound was qualified U at its reported value.

V. **Surrogate Recovery:** ACCEPTABLE/All criteria met.

VI. **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses:** ACCEPTABLE/ All criteria met.

VII. **Field Duplicates:** NOT SUBMITTED

VIII. **Internal Standards Performance:** ACCEPTABLE/All criteria met.

IX. **Compound Identification:** ACCEPTABLE/All criteria met.

X. **Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL):** ACCEPTABLE/All criteria met.

XI. **Tentatively Identified Compounds (TIC):** ACCEPTABLE/All criteria met.

XII. **System Performance:** ACCEPTABLE/All criteria met.

XIII. **Overall Assessment of the Data**

The data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
SEMIVOLATILE ORGANICS ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. GC/MS Instrument Performance Checks: ACCEPTABLE/All criteria met.

III. Initial and Continuing Calibration: ACCEPTABLE/With the following discussion.

Qualified Data: None

Discussion

The relative response factor (RRF) and the relative standard deviation (%RSD) for the initial calibration were evaluated and all criteria were met. The percent difference (%D) between initial and continuing calibration RRF exceeded the 25 percent criteria for 4-nitroaniline and 3,3'-dichlorobenzidine. Because the %D values were negative, increased instrument sensitivity was indicated, and the detection limits were not affected. Since neither of these compounds were detected in the samples, no qualifiers were assigned.

IV. Blank Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Blank Value	Action Limit
Unknown Hydrocarbon at RT = 5.84 min	R	NMW-13A	4 µg/L	40 µg/L
Unknown Hydrocarbon at RT = 13.68 min	R	NMW-13A	7 µg/L	70 µg/L
Unknown Hydrocarbon at RT = 8.55 min	R	NMW-15A	6 µg/L	60 µ/L
Unknown Hydrocarbon at RT = 13.10 min	R	NMW-15A	6 µg/L	60 µg/L

Compound	Qualifier	Sample Number	Blank Value	Action Limit
Unknown Hydrocarbon at RT = 13.68 min	R	NMW-15A	4 µg/L	40 µg/L
Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	R	NMW-15A	2 µg/L	20 µg/L

Discussion

The method blank associated with these samples was free of target compounds above the detection limit. Several tentatively identified compounds (TIC) were detected in the blank. Samples with these TIC present at a concentration below the action limit of 10 times the blank level have been qualified R as rejected. Qualified data are summarized in the above table.

V. Surrogate Recovery: ACCEPTABLE/All criteria met.

VI. Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses: ACCEPTABLE/ With the following discussion.

Qualified Data: None

Discussion

Analysis of MS/MSD were performed at the proper frequency. All of the relative percent difference (RPD) values were within the specified control limits.

The percent recovery values exceeded the upper control limits for 4-nitrophenol, and pentachlorophenol. No positive sample results were reported for these compounds. No data were qualified on the basis of MS/MSD results alone.

VII. Field Duplicates: NOT SUBMITTED

VIII. Internal Standards Performance: ACCEPTABLE/All criteria met.

IX. Compound Identification: ACCEPTABLE/All criteria met.

X. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL): ACCEPTABLE/All criteria met.

XI. Tentatively Identified Compounds (TIC): ACCEPTABLE/All criteria met.

XII. System Performance: ACCEPTABLE/All criteria met.

XIII. Overall Assessment of the Data

Data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
POLYNUCLEAR AROMATIC HYDROCARBON ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Instrument Performance: ACCEPTABLE/All criteria met.

III. Calibration: ACCEPTABLE/All criteria met.

IV. Blank Analyses: ACCEPTABLE/All criteria met.

V. Surrogate Recovery: ACCEPTABLE/All criteria met.

VI. Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Analyses: ACCEPTABLE/ With the following discussion.

Qualified Data: None

Discussion:

Analysis of MS/MSD were performed at the proper frequency, and all relative percent difference values were within QC limits. The percent recovery value for the acenaphthylene MSD was above the upper control limit. Examination of the chromatograms showed this to be a matrix effect. A closely eluting peak in the sample's extract interfered with the elution of acenaphthylene. Acenaphthylene was not detected in the sample; therefore, no data were affected. All other percent recovery values were within QC limits.

VII. Field Duplicates: NOT SUBMITTED

VIII. Compound Identification: ACCEPTABLE/All criteria met.

IX. Compound Quantitation and Contract Required Quantitation Limits (CRQL): ACCEPTABLE/All criteria met.

X. Overall Assessment of the Data

The data, as reported, are acceptable for use.

DATA VALIDATION REPORT
TOTAL PETROLEUM HYDROCARBON ANALYSIS

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Instrument Calibration: ACCEPTABLE/All criteria met.

III. Blank Analyses: ACCEPTABLE/All criteria met.

IV. Laboratory Control Sample: ACCEPTABLE/All criteria met.

V. Duplicate Sample Analyses: ACCEPTABLE/With the following discussion.

Qualified Data: None

Discussion:

The method states that per sample set, one duplicate per ten samples is to be analyzed to meet QC requirements. A duplicate analysis from this sample set was not performed; however, data from a duplicate analysis of a sample analyzed in the same analytical batch was submitted for review. Precision was good with a relative percent difference of 13 percent. Because no hydrocarbons were detected in the samples in this set, no qualifiers were assigned on the basis of duplicate analysis.

VI. Spike Sample Analyses: NOT REQUIRED

Matrix Spike/Matrix Spike Duplicate (MS/MSD) QC are not required by the State of Washington method WTPH-418.1 Modified.

VII. Sample Result Verification: ACCEPTABLE/All criteria met.

VIII. Field Duplicates: NOT SUBMITTED

IX. Overall Assessment of the Data

The data, as reported, are acceptable for use.

REFERENCES

Kennedy/Jenks/Chilton. 1991. Quality Assurance Project Plan South Tacoma Field Superfund Site, Tacoma, Wa. March.

U.S. Environmental Protection Agency. 1986. Test Methods for Evaluating Solid Waste. SW-846, Third Edition.

U.S. Environmental Protection Agency. 1988. Functional Guidelines for Evaluating Organic Analyses. R-582-5-5-01.

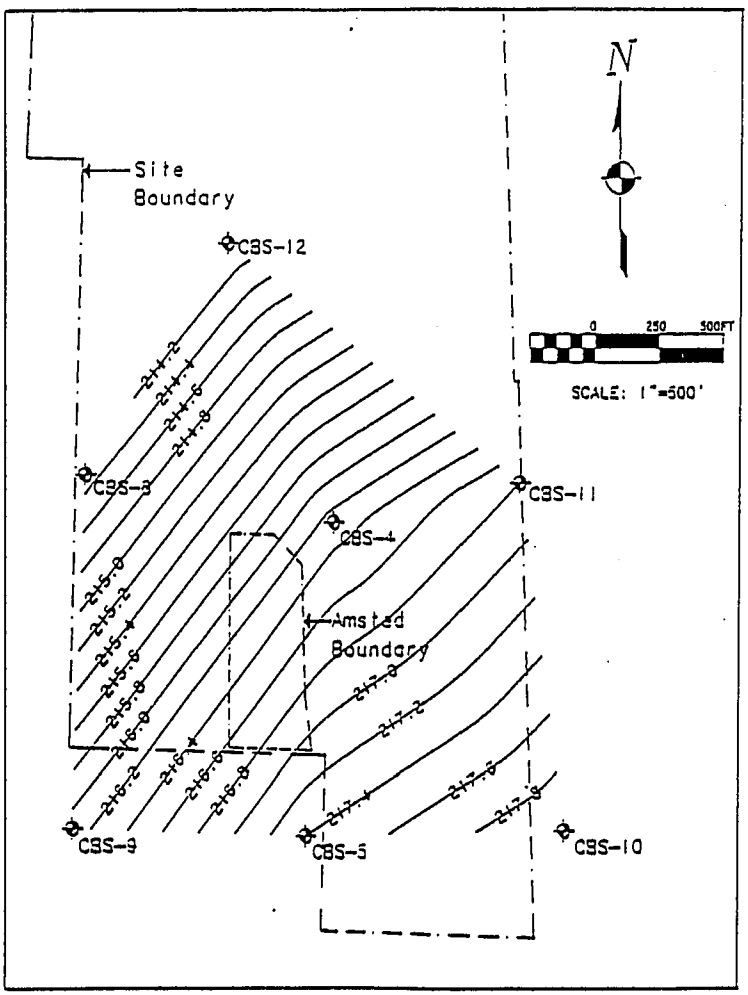
U.S. Environmental Protection Agency. 1990. Contract Laboratory Program Statements of Work for Organics. OLM01.0.

Washington State Department of Ecology. 1991. Guidance for Remediation of Releases from Underground Storage Tanks. Appendix L.

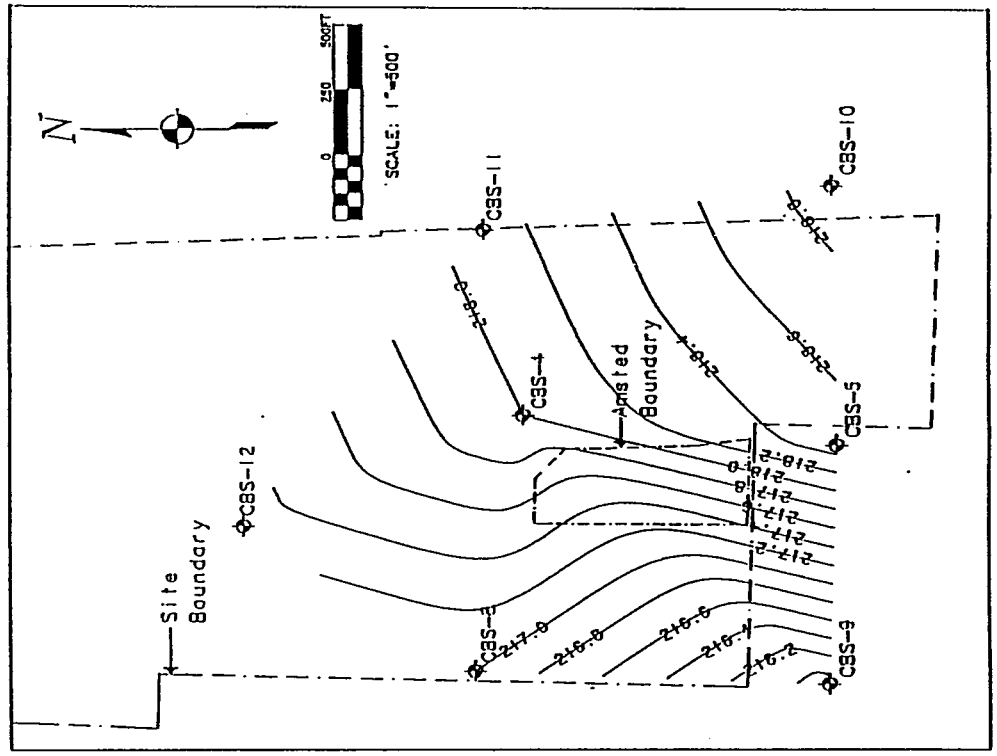
Appendix H

Groundwater Contour Maps

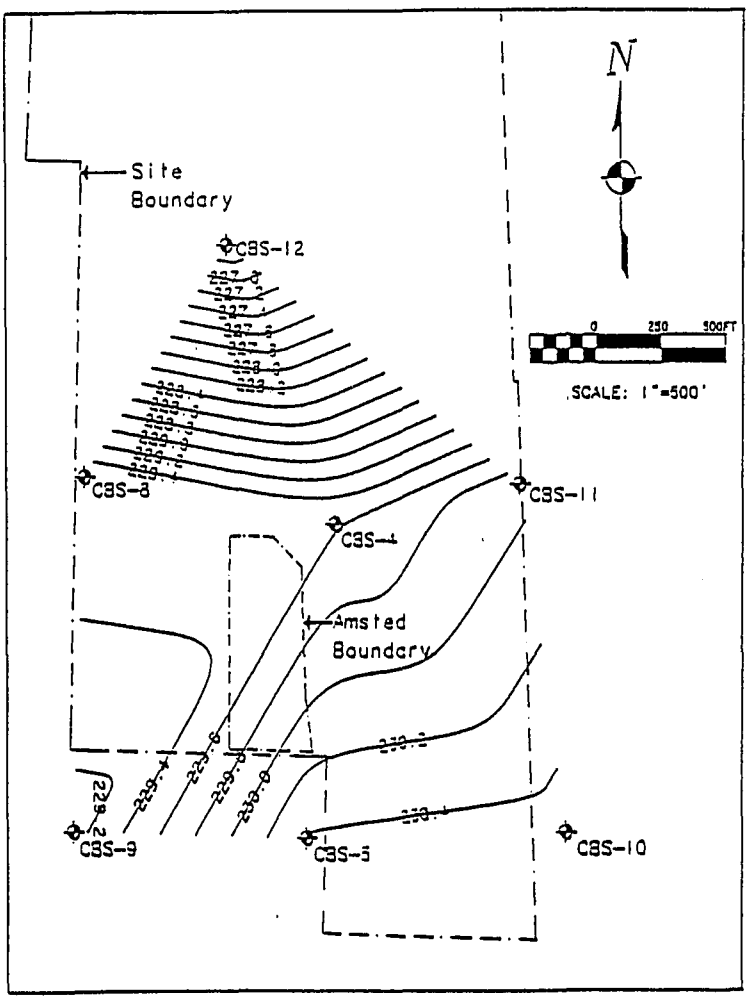
South Tacoma Field
Groundwater Contours
14 October, 1982



South Tacoma Field
Groundwater Contours
24 November, 1982



South Tacoma Field
Groundwater Contours
22 August, 1989



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Groundwater Contours
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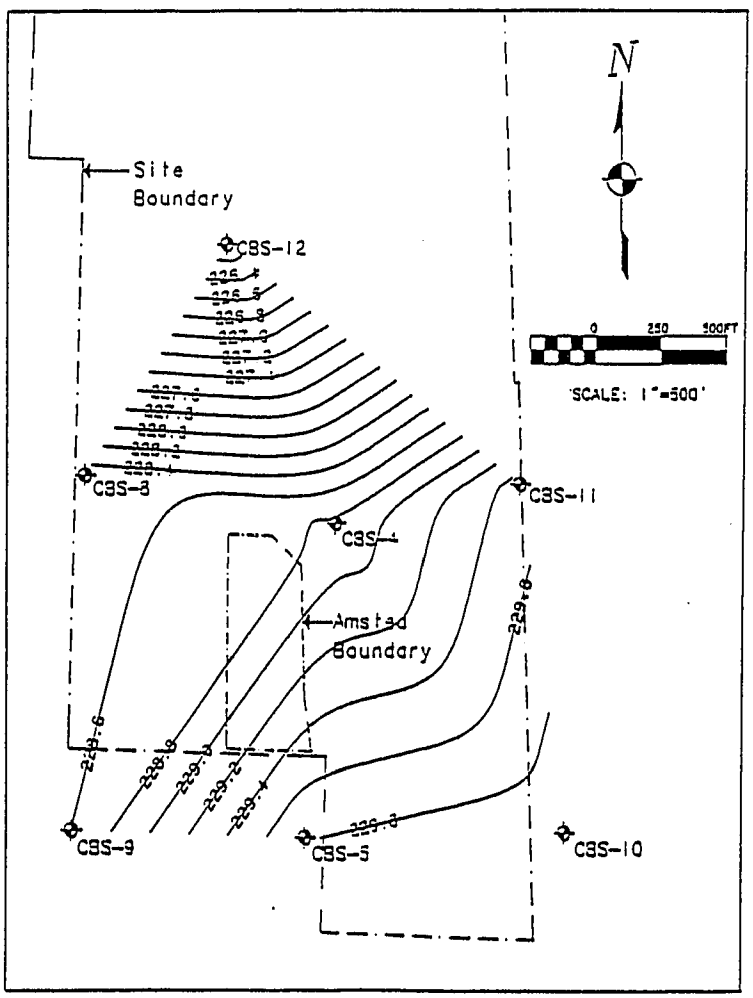

South Tacoma Field
Groundwater Contours
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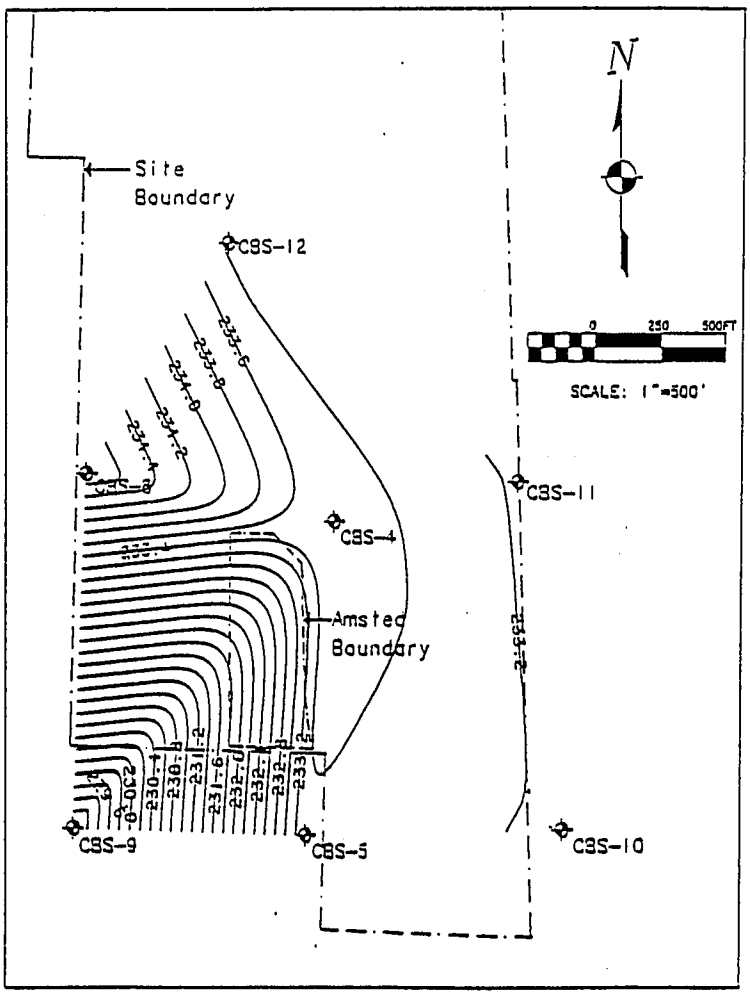
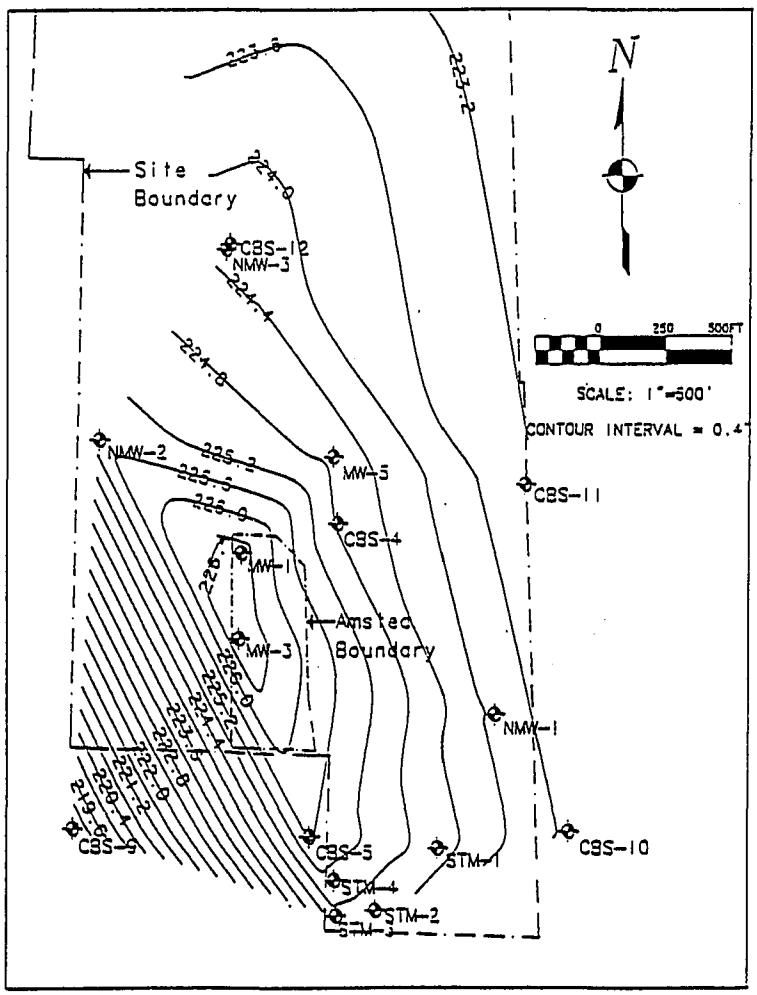
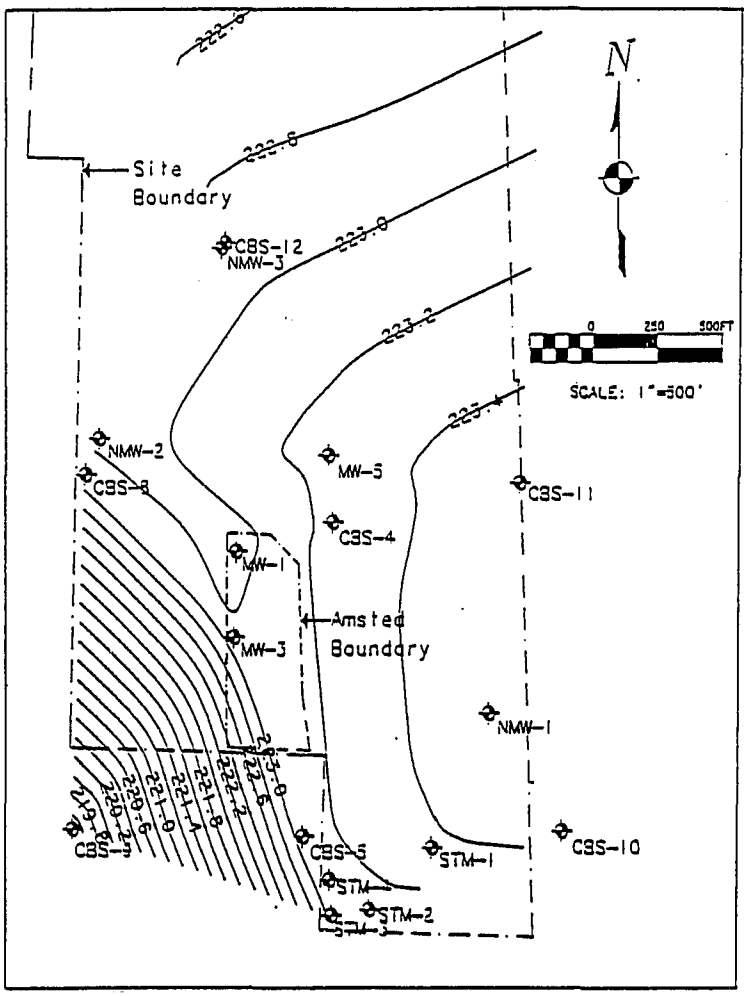


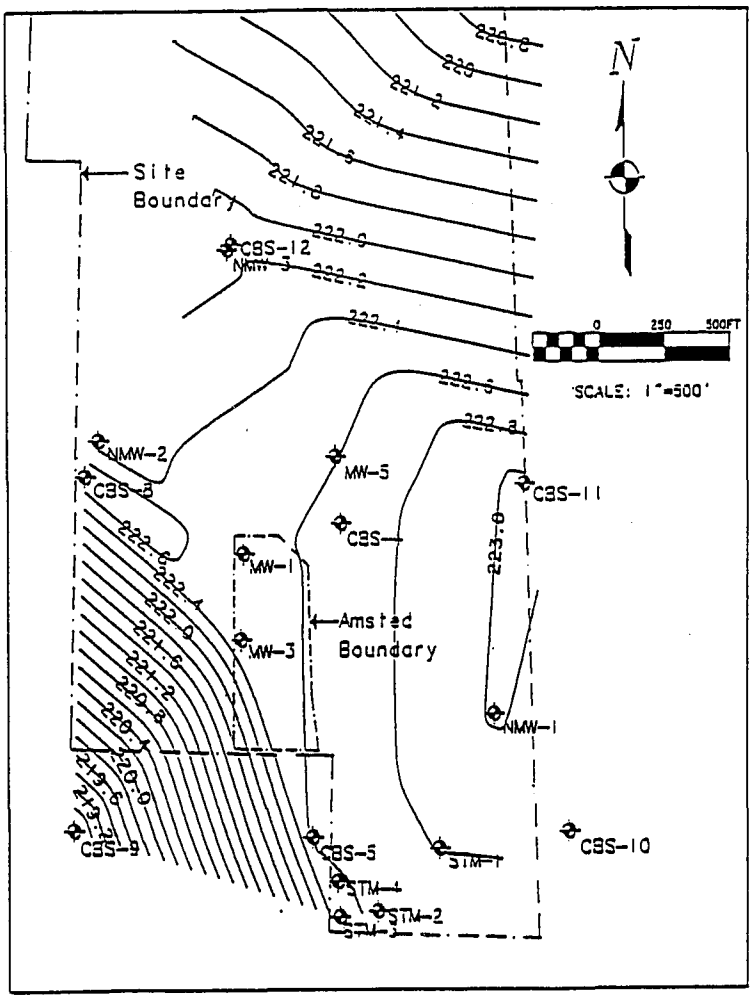
South Tacoma Field
Groundwater Contours
11 April, 1991



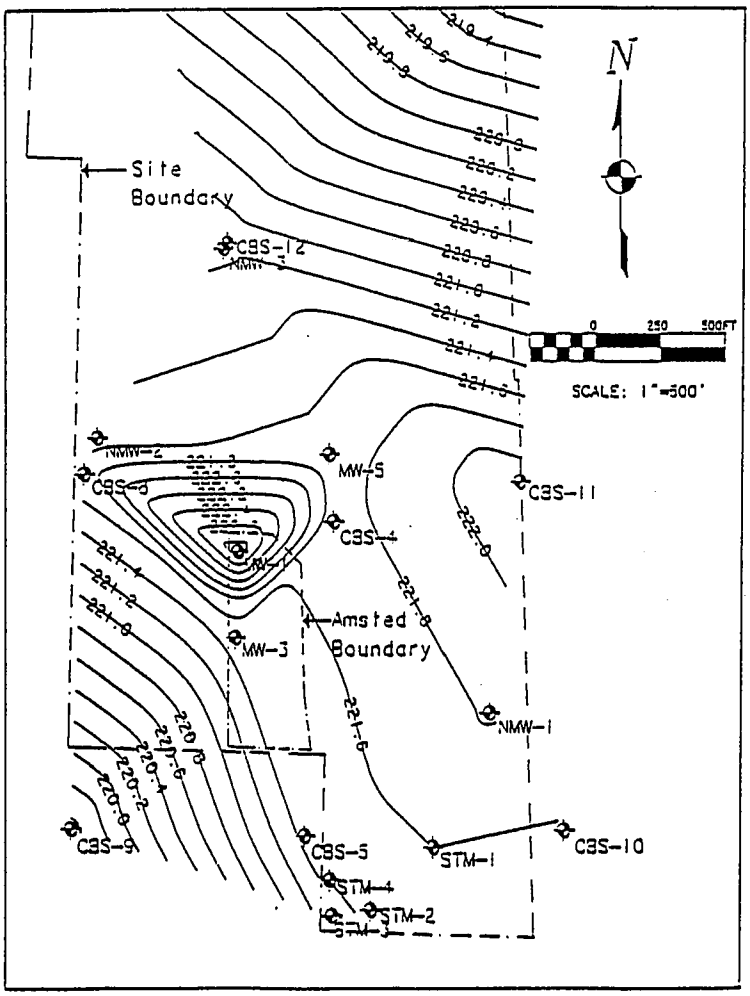
South Tacoma Field
Groundwater Contours
9 May, 1991



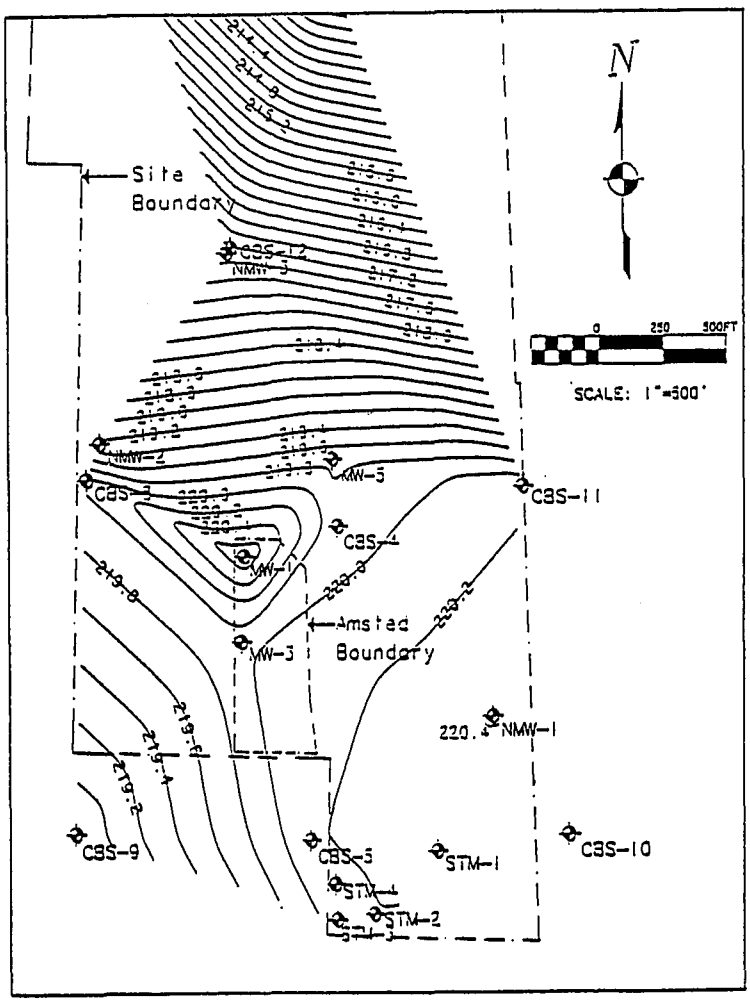
South Tacoma Field
Groundwater Contours
7 June, 1991



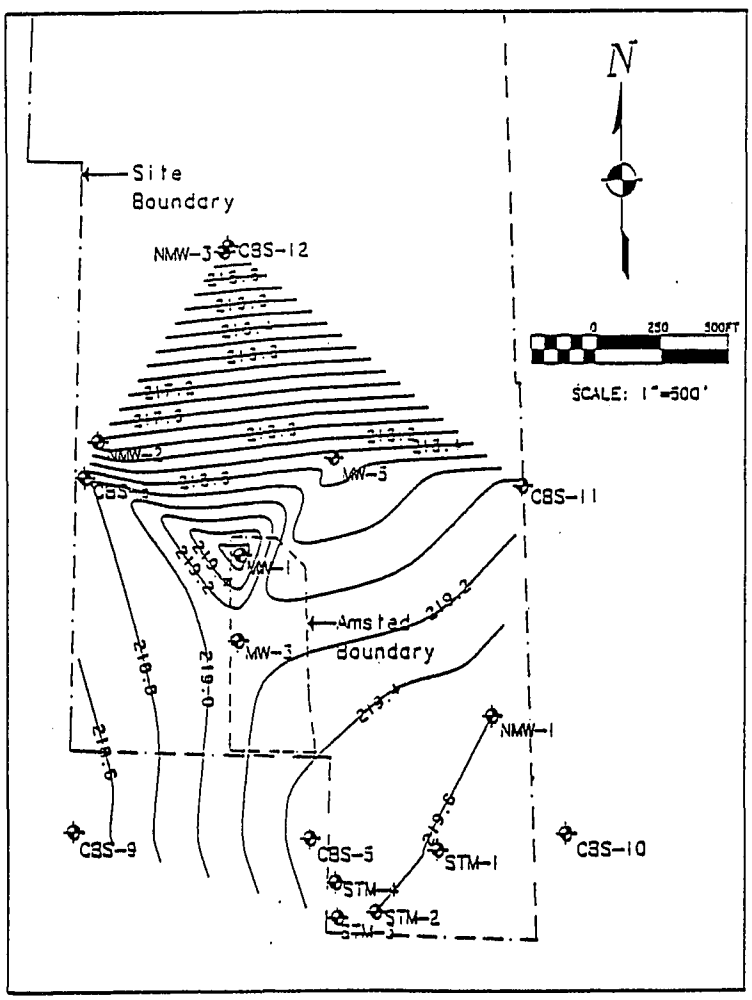
South Tacoma Field
Groundwater Contours
11 July, 1991



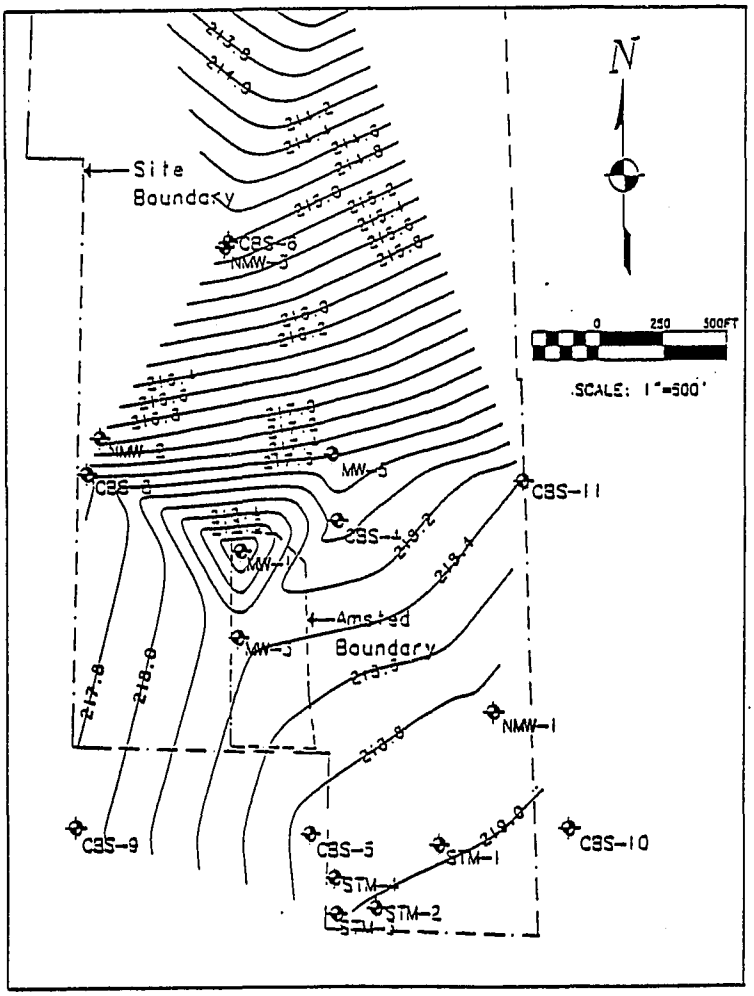
South Tacoma Field
Groundwater Contours
8 August, 1991



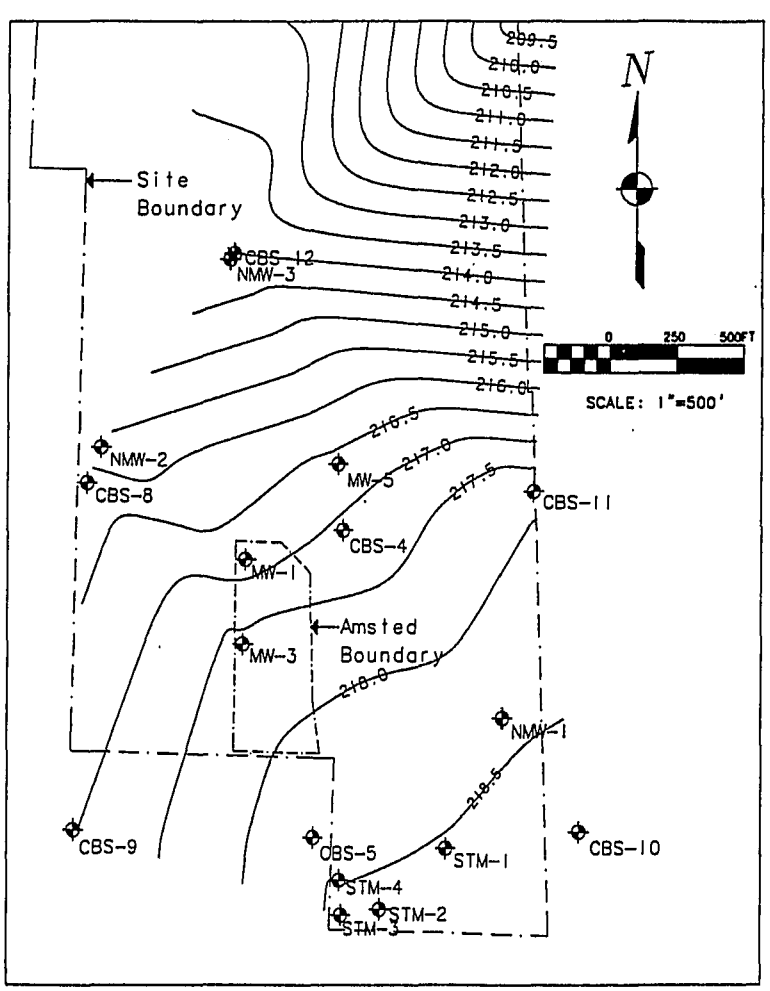
South Tacoma Field
Groundwater Contours
23 August, 1991



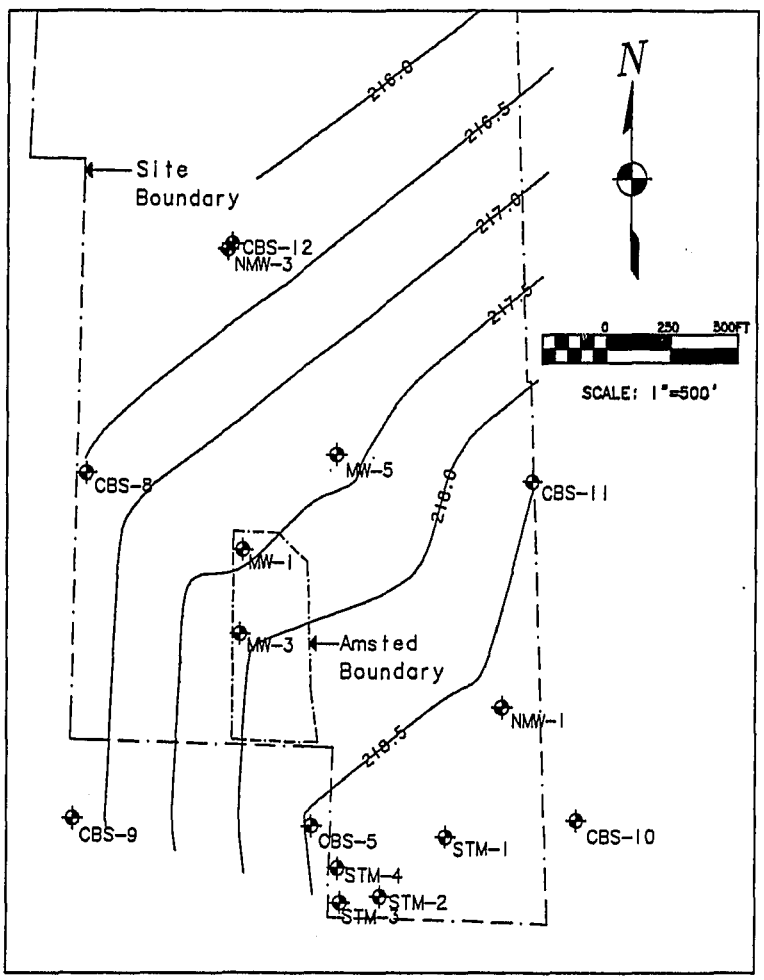
South Tacoma Field
Groundwater Contours
9 September, 1991



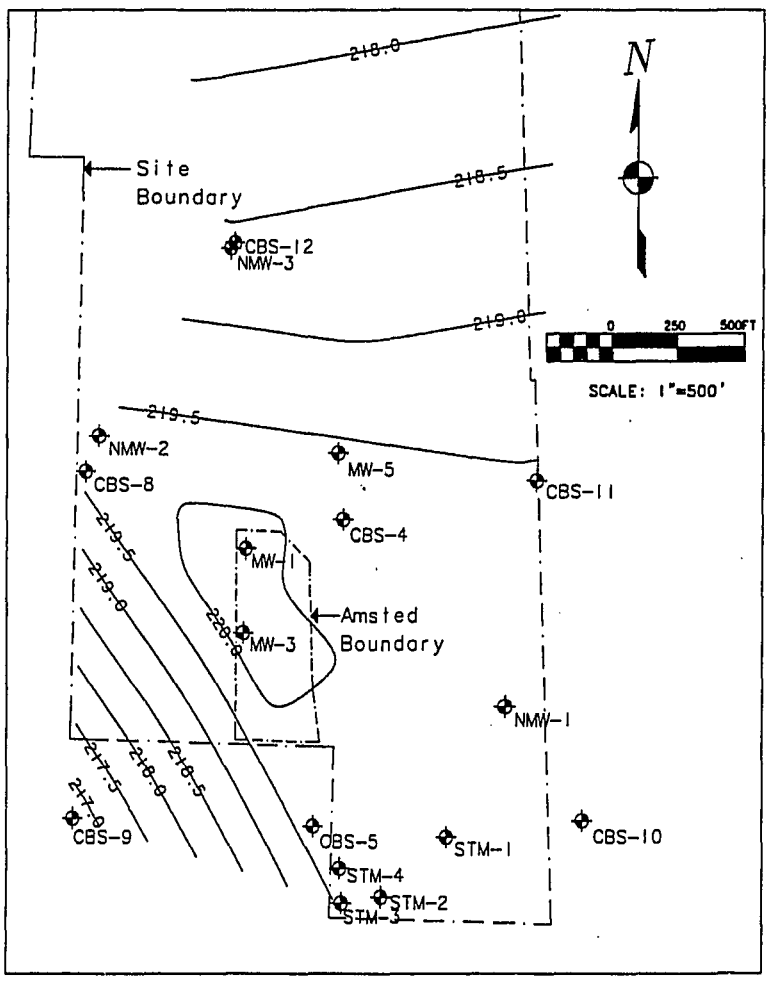
South Tacoma Field
Groundwater Contours
17 October 1991



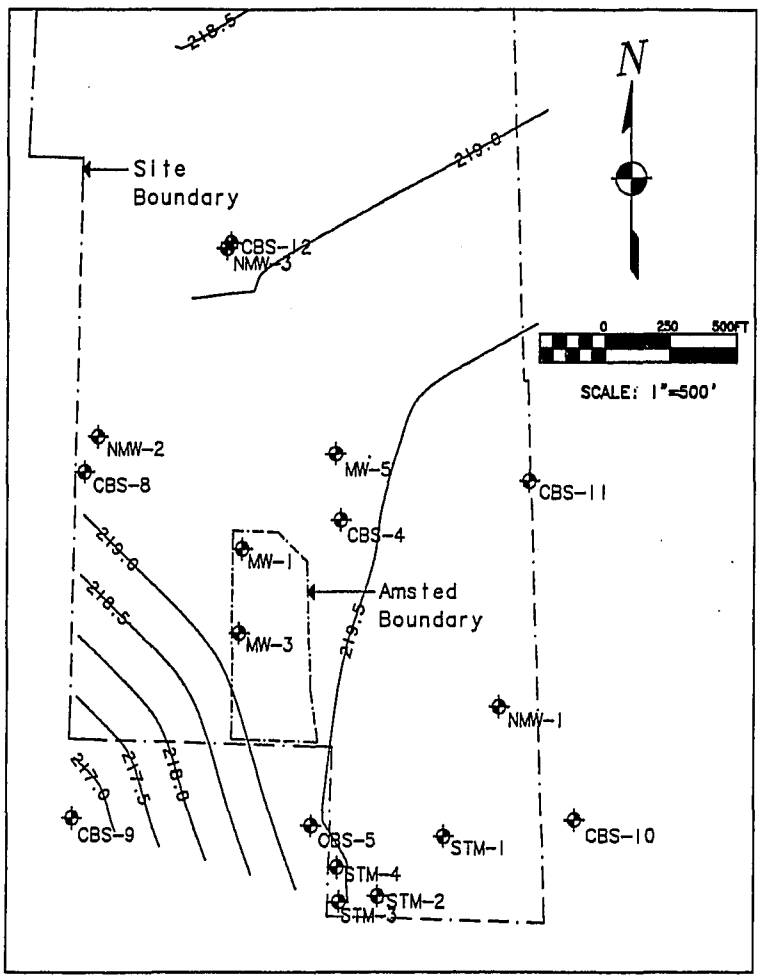
South Tacoma Field
Groundwater Contours
11 November 1991



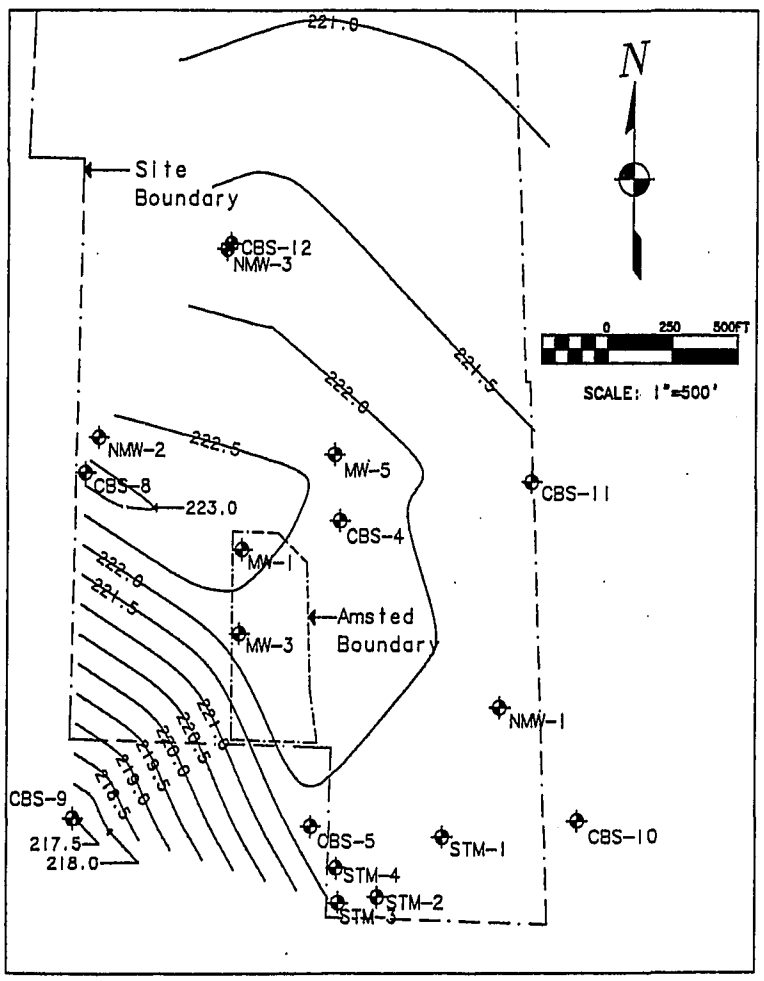
South Tacoma Field
Groundwater Contours
9 December 1991



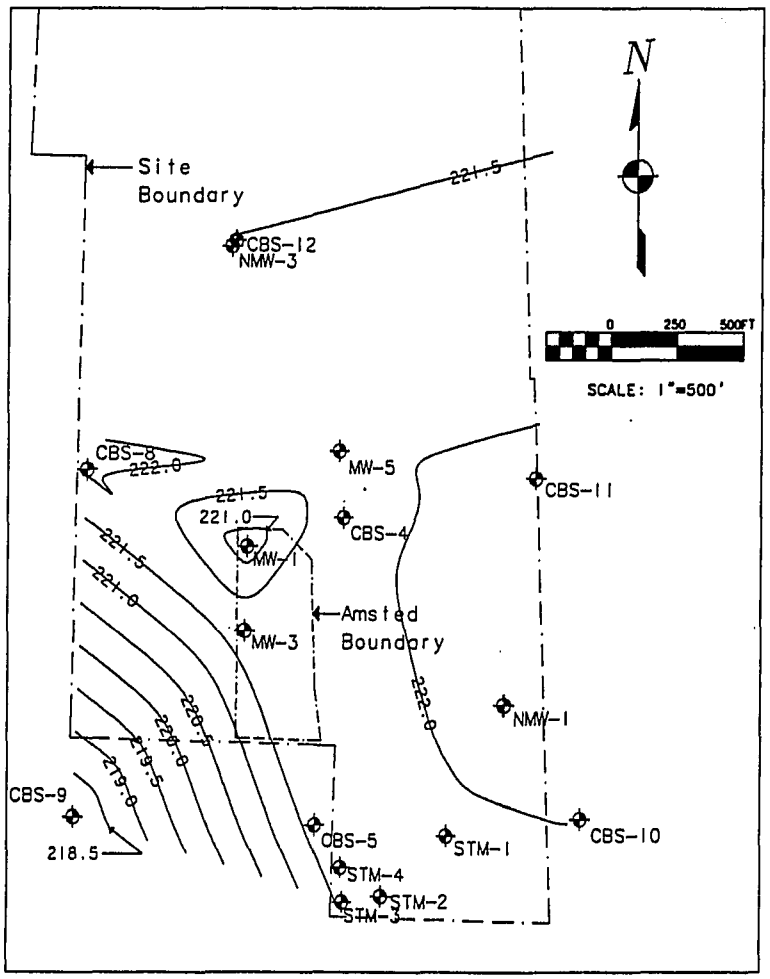
South Tacoma Field
Groundwater Contours
7 January 1992



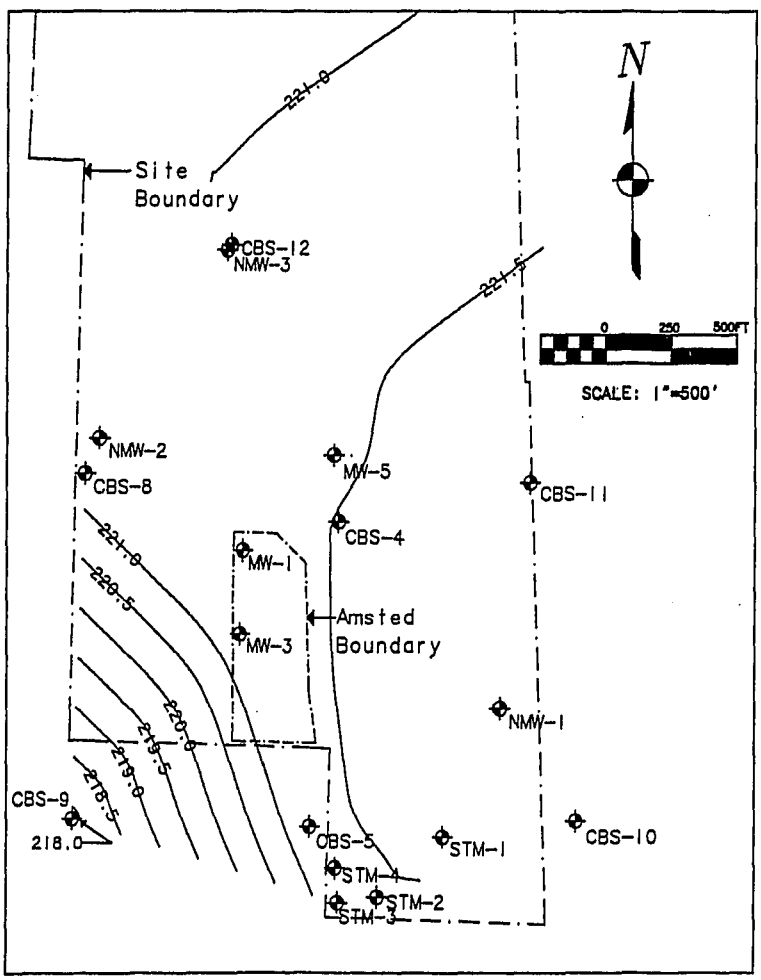
South Tacoma Field
Groundwater Contours
11 February 1992



South Tacoma Field
Groundwater Contours
13 March 1992



South Tacoma Field
Groundwater Contours
30 March 1992



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

OVERSIZED DOCUMENT

The page that occupies this position in the Administrative Record is:

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Document Description: FIGURE 4
DISSOLVED PLUME CONTAMINANT PROJECTION

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U.S. Environmental Protection Agency
Region 10
Superfund Records Center
1200 Sixth Avenue, ECL-076
Seattle, WA 98101-1128
(206) 553-4494

Appendix I

Excerpts from Remedial Investigation/Feasibility Study
South Tacoma Field Superfund Site
Tacoma, Washington

Remedial Investigation Report
Appendices Volume 4 of 6

4.1.4.1 Regional Groundwater System. In general, the regional groundwater system in the uppermost unconfined aquifer is characterized by recharge in the Fircrest/Tacoma upland with shallow groundwater flow east and west to the Puyallup River Valley and to Puget Sound, respectively. The divide between east and west flow occurs in the vicinity of the South Tacoma Channel (Black & Veatch 1990). The STF site and surrounding vicinity are located within a recharge area. Groundwater is presumed to flow from the recharge areas in the central portion of the Fircrest/Tacoma upland toward the discharge areas to the west, north, northeast, and south (Black & Veatch 1987). Puget Sound and Commencement Bay form sea level discharge areas to the west and north. The discharge area for the groundwater that flows beneath the Tacoma Landfill to the west of the site is Leach Creek (Black & Veatch 1990) (see Figure GW-6).

The STF site is located within the Clover/Chambers Creek surface water drainage basin. The general direction of the groundwater hydraulic gradient in this basin is southeast to northwest (Brown and Caldwell 1985). This hydraulic gradient direction coincides with the hydraulic gradient direction observed in the upper aquifer at the STF site when the City of Tacoma is not pumping from the wellfield to the east of the site. The character of, and seasonal changes in, the shallow groundwater hydraulic gradient direction are described in Section 4.1.4.2.

4.1.4.2 Local Groundwater System. Based on available potentiometric surface data, the STF site appears to lie within a groundwater recharge area. Based on preliminary information gathered during the Surface Water and Sediment Investigation of the STF RI, it appears that precipitation and surface water from the open channel in the northwestern portion of the site does not flow offsite as surface water, except during major rainfall events. Surface water is believed to dissipate by evaporation, transpiration, and infiltration downward through the unsaturated zone as recharge to the saturated zone.

The unsaturated zone at the STF site is composed mainly of the upper portion of the Colvos Sand unit. Other local deposits comprising the uppermost unsaturated

zone include fine-grained sediment and organic material in the Former Swamp/ Lakebed area and areas of fill material. The uppermost portion of the saturated zone, or upper aquifer, at the STF site is within the Colvos Sand unit, as described in Section 4.1.2. Most of the wells at the STF site are screened in the uppermost part of the Colvos Sand in poorly graded to well graded, fine- to medium-grained sand. Where observed, the lower portion of the upper aquifer consists mainly of gravel.

The top of the saturated zone was encountered at depths ranging from near ground surface in the Former Swamp/Lakebed area to approximately 35 feet BGS in the southeastern portion of the site. However, maximum potentiometric head differences in each uppermost aquifer well were on the order of 6 feet throughout the year. The surface housing above monitoring well CBS-8A, in a low portion of the Former Swamp/Lakebed area, was observed to be submerged under approximately 1.5 feet of surface water during the April monthly water level monitoring event. The depth to the uppermost saturated zone varies seasonally, a difference on the order of 10 feet over much of the site. These seasonal variations in depth to the unsaturated zone are dependent on climatic conditions and pumping of the City of Tacoma wellfield to the east of the site.

Figures GW-11 through GW-24 are contour maps of the potentiometric surface of the upper aquifer for the months of April 1991 through March 1992. The locations of the City of Tacoma production wells 4A, 6A, and 11A are also shown in Figures GW-11 through GW-24. (The letter designation "A" for the City of Tacoma wells bears no relation to the "A" designation used for monitoring wells during this investigation). The contour maps show the estimated hydraulic gradient directions for the days the groundwater levels were measured. The maps illustrate the seasonal variations in groundwater levels and seasonal reversals in hydraulic gradient due to pumping of the City of Tacoma production wells. The hydraulic gradient directions are used in this report as approximations of the groundwater flow directions in the upper aquifer under isotropic conditions. Most field conditions are anisotropic, however, and actual flow directions vary accordingly. The

water level elevations in upper aquifer wells were initially contoured using the triangular network program pcTIN Version 2.20. Modifications were manually made to the computer-generated contour lines based on observations of field conditions. Because water level data were not available for the City of Tacoma pumping wells, contours were estimated based on known information.

The South Tacoma Channel in the vicinity of the STF site appears to act as a local recharge area for groundwater. The natural hydraulic gradient (when not influenced by regional pumping) in the upper aquifer appears to be from the southeast to the northwest across the site, following the regional pattern of hydraulic gradient directions described in Section 4.1.4.1. The natural hydraulic gradient direction in the west central portion of the site appears to be to the west, toward the Tacoma Landfill (see Figure GW-12). A steep hydraulic gradient exists throughout the year in the southwestern portion of the site, where the assumed groundwater flow direction observed during this investigation was always from the east to the west. The hydraulic gradient direction was observed to vary from the northwest to the southwest in the southwestern portion of the site.

Based on available potentiometric surface data for the upper aquifer, a natural groundwater divide appears to be located in the vicinity of the South Tacoma Channel. This divide shifts to the west toward or in the vicinity of the Tacoma Landfill when the City of Tacoma production wells are pumping (Black & Veatch 1987). The presence of this divide in the vicinity of the South Tacoma Channel appears to be due in part to the absence of the poorly transmissive glacial till unit that typically overlies the Colvos Sand in the region. The more highly transmissive Colvos Sand is exposed in the South Tacoma Channel and should promote more rapid infiltration of precipitation and surface water through the unsaturated zone into the saturated zone. Other subsurface features, such as aquifer grain size variations and aquifer thickness variations, also may have an impact on recharge characteristics of the aquifer.

During times when the City of Tacoma was not pumping from the wellfield to the east of the STF site (April, early May, and November through March), groundwater in the upper aquifer appears to have mounded in the southern portion of the site. A recharge mound centered in the vicinity of Amsted during the 11 April 1991 monitoring event may have been due to precipitation events that occurred in March and early April. More than 6 inches of rain fell on McChord Air Force Base to the south of the STF site during the first week in April. The actual location of the center of the mound may have been to the west of the Amsted property in the area of the open channel or Former Swamp/Lakebed area.

Hydraulic gradient reversals have been documented in the past for the STF site and the Tacoma Landfill to the west (Black & Veatch 1987, 1990). These reversals occurred in the upper aquifer and were caused by pumping of the City of Tacoma production wells to the east. Pumping of these wells began in early May 1991 and continued until early October 1991. Most of the pumping of nearby production wells during these months was conducted from wells 6A and 11A. Well 4A was pumped only during the months of July and August 1991 (Gibson, C., 4 December 1991, personal communication). Production wells 4A, 6A, and 11A are screened at various intervals, beginning at an uppermost elevation of approximately 190 feet above MSL to a lowermost elevation of approximately 75 feet above MSL in well 4A. The upper elevation of 190 feet above MSL roughly corresponds with the elevation of the lower part of the upper aquifer at the STF site. Most of the groundwater production this year was from well 11A (Gibson, C., 4 December 1991, personal communication), which is screened entirely in the interval designated by Carr/Associates (1991) as the shallow aquifer. The shallow aquifer appears to be correlative with part of the upper aquifer at the STF site.

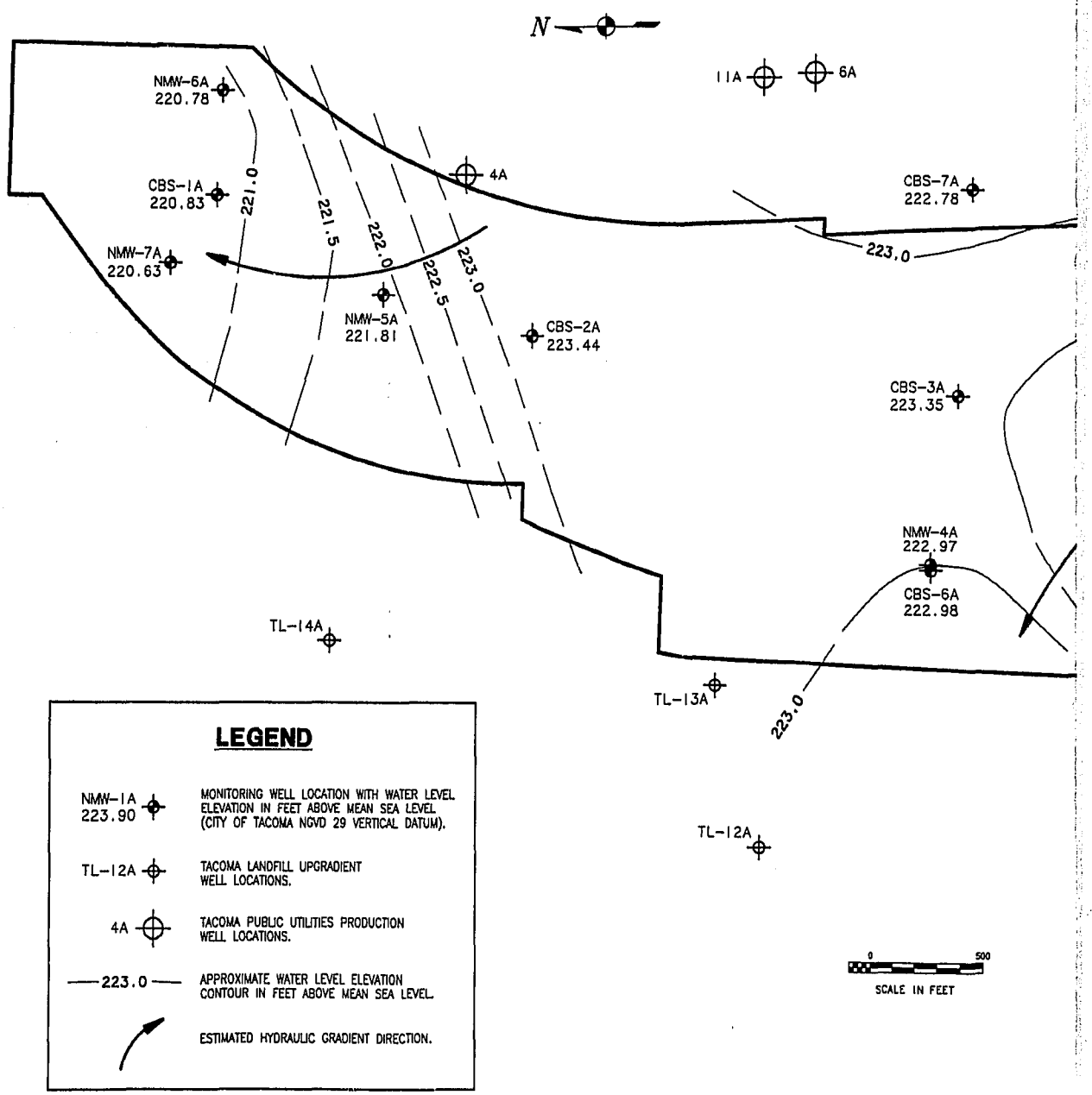
The potentiometric surface in the upper aquifer at the STF site was affected throughout most of the site by pumping of the City of Tacoma production wells during the monthly monitoring events of June through October 1991 (see Figures GW-13 through GW-18). The Tacoma Landfill wells that were used as upgradient wells during this investigation (TL-12A, TL-13A, TL-14A, and TL-23A) are located

in the area affected by gradient reversals during pumping (see Figures GW-11 through GW-18). These wells were actually hydraulically upgradient of the STF site only during times of gradient reversals (approximately half of the year) and were hydraulically downgradient of the STF site during other times of the year.

The hydraulic gradient reversals are characterized by a cone of depression that usually appears to be centered on the City of Tacoma production wells 6A and 11A. During the monthly monitoring events of June and July, only the central section of the STF site appeared to be affected by gradient reversals (see Figures GW-13 and GW-14). During the monthly monitoring events of August, September, and October, gradient reversals were also observed in upper aquifer at the northern end of the site (see Figures GW-15 through GW-18). The extreme southwest corner of the STF site is the only area apparently unaffected by these gradient reversals, with the estimated hydraulic gradient direction always toward the southwest, west, or northwest when observed during this investigation. The hydraulic gradient appears to be less steep, however, during the months of pumping the City of Tacoma production wells.

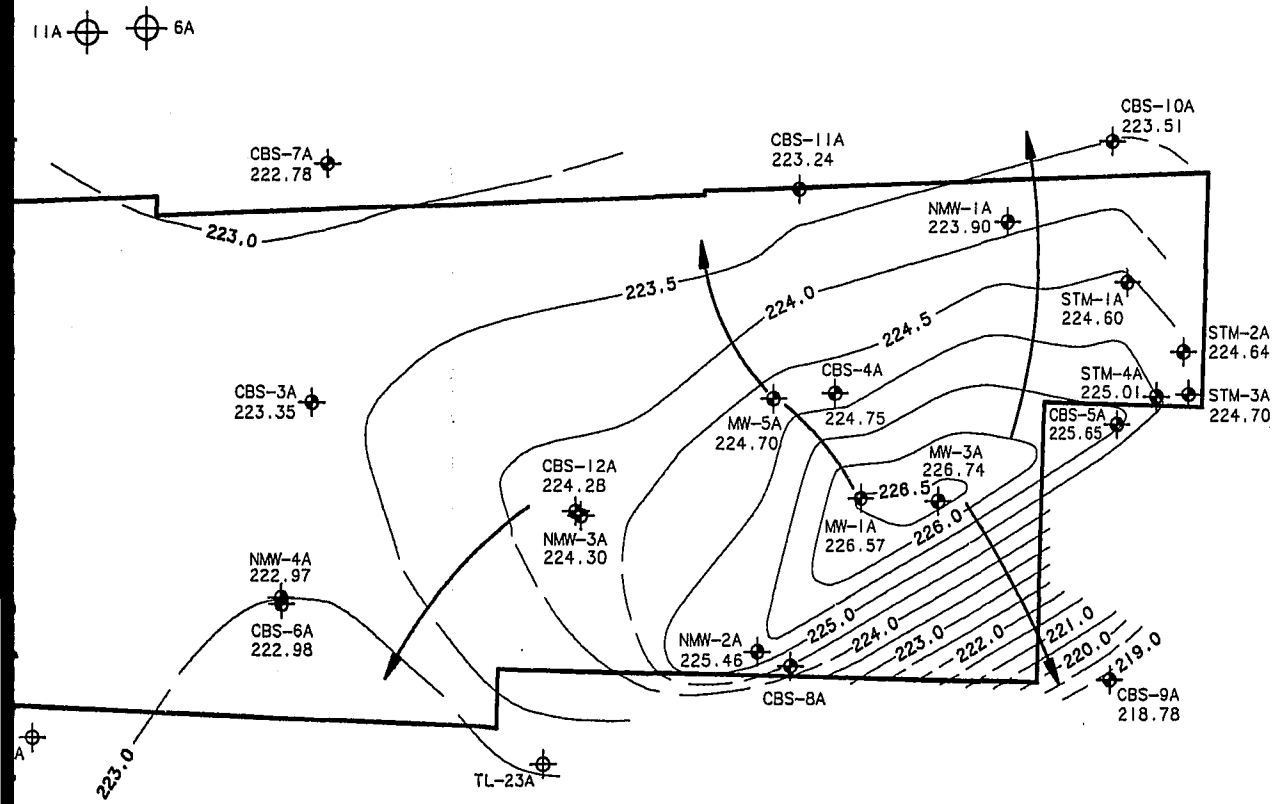
Two well clusters were installed during this investigation. These well clusters were numbered NMW-3 and NMW-5. Three wells were installed in each cluster, and the wells were designated with the letters A, B, and C indicating screening of the upper, intermediate, and deep aquifers, respectively. Figure GW-9 is a cross section through the two well clusters that shows the locations of the screened intervals of the well clusters with respect to the site stratigraphy. Measured differences in hydraulic heads for the well clusters during the monthly water level monitoring events showed a vertical downward gradient at both well clusters. This downward gradient indicates a net downward flow of groundwater over time from the upper aquifer to the intermediate and deep aquifers.

Laboratory measurements of vertical hydraulic conductivity were performed on soil samples collected from the upper aquifer. Porosity was also calculated for these samples. Results of these measurements are presented in Section 5.4. Further characterization of the upper, intermediate, and deep aquifer and possible inter-communication among the aquifer zones is described in the Hydraulic Characterization Investigation Report (see Appendix HC of the RI Report).



LEGEND

NMW-1A 223.90	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



0 500
SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. CBS-8A WAS SUBMERGED IN SURFACE WATER DURING THIS MONITORING EVENT.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

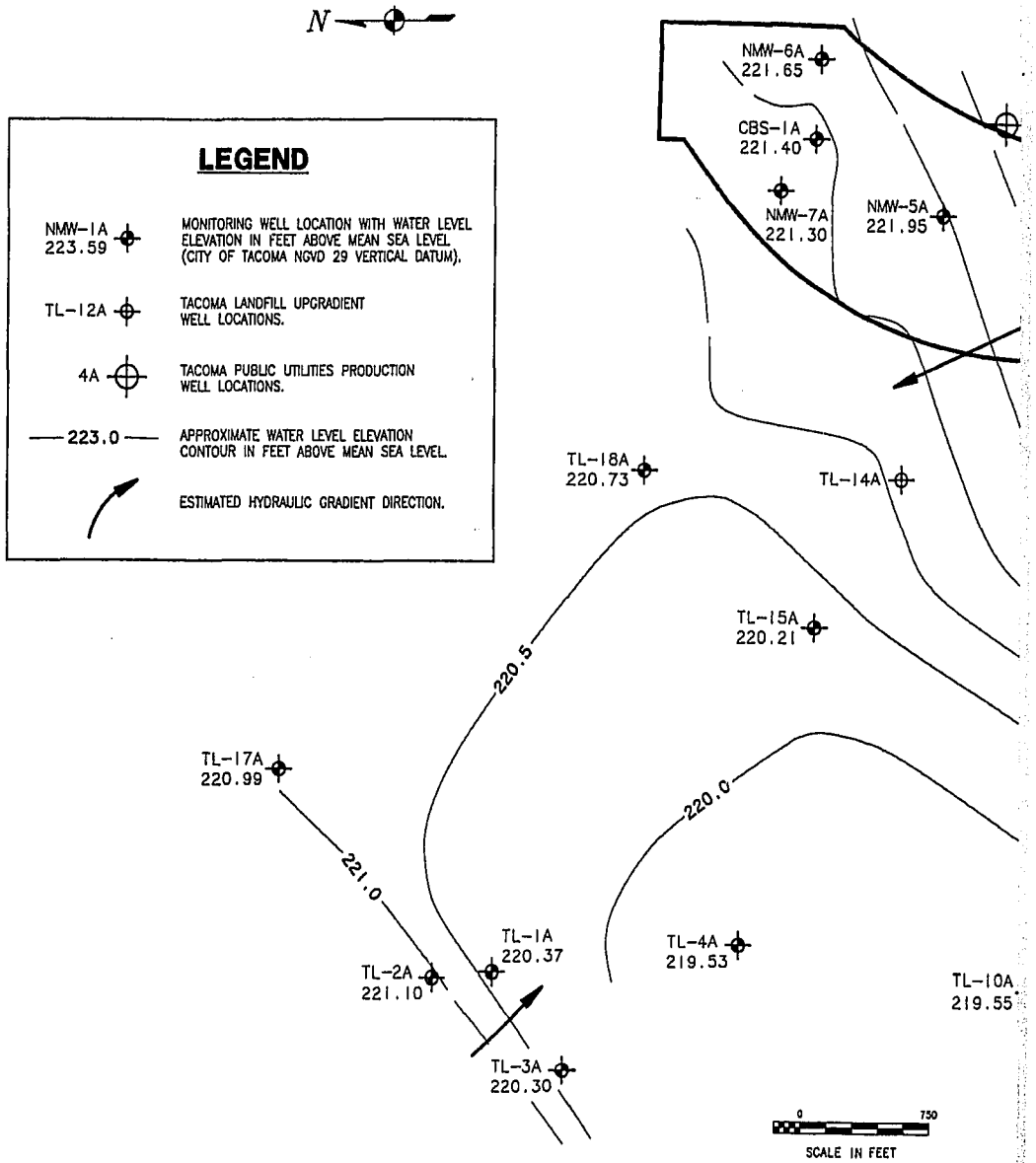
Kennedy/Jenks Consultants

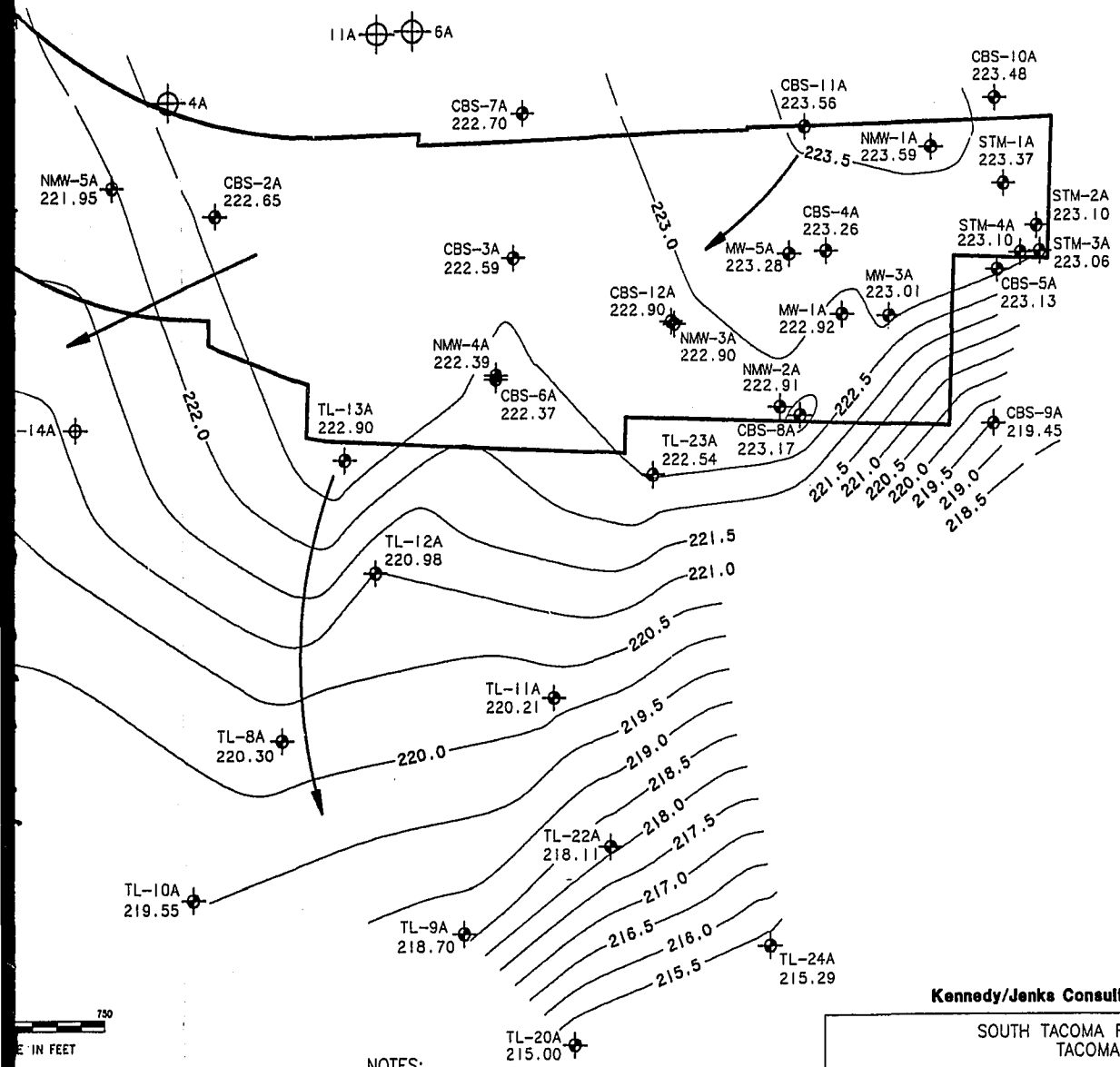
SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 11 APRIL 1991

916055.08/P1SK329

FIGURE GW-11





NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.

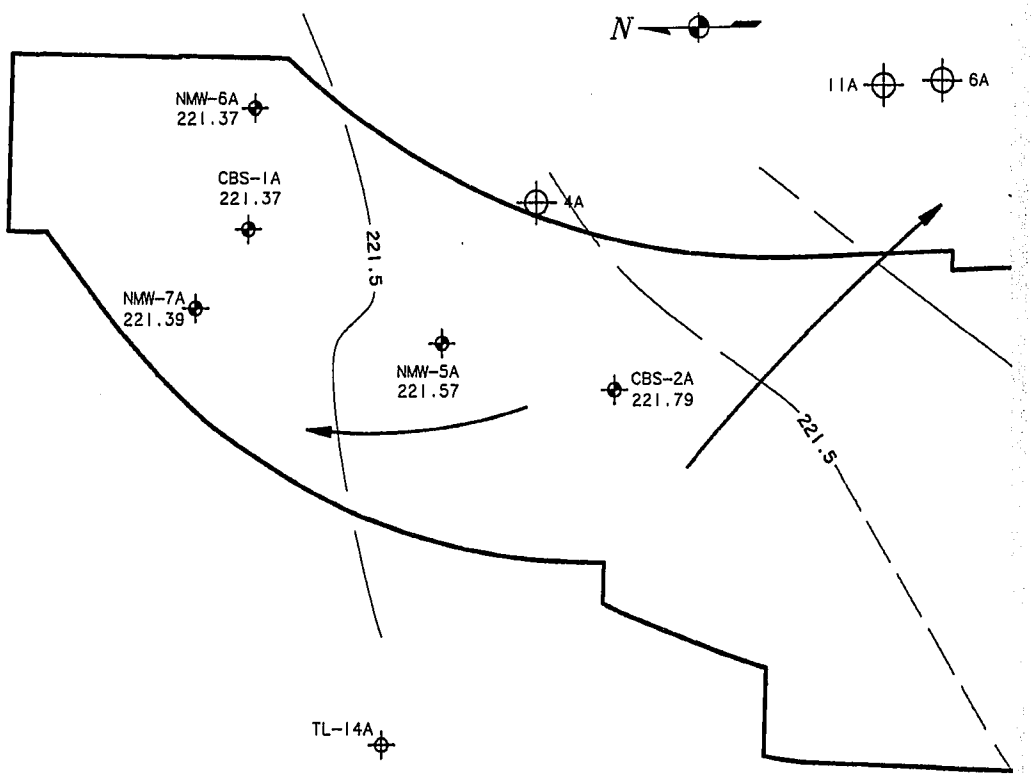
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 9 & 11 MAY 1991

916055.08/P1SK330

FIGURE GW-12



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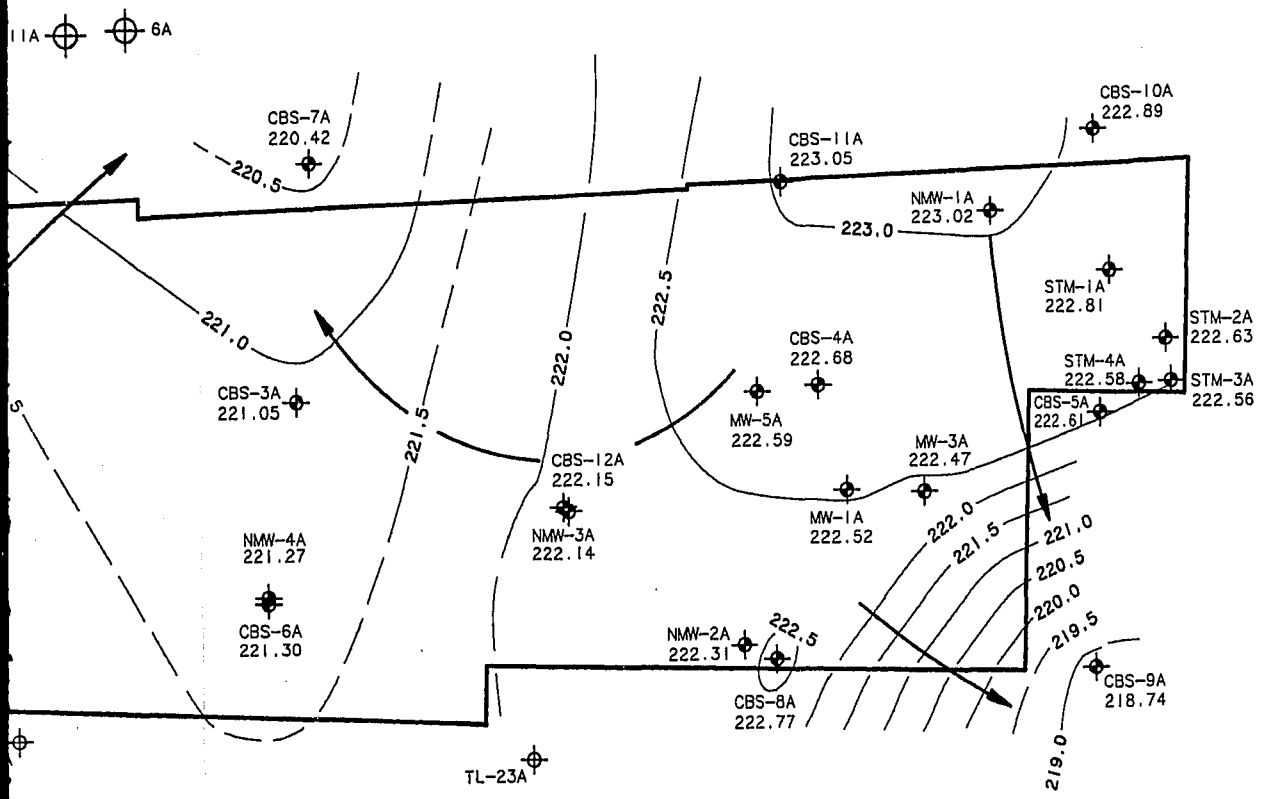
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



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SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.

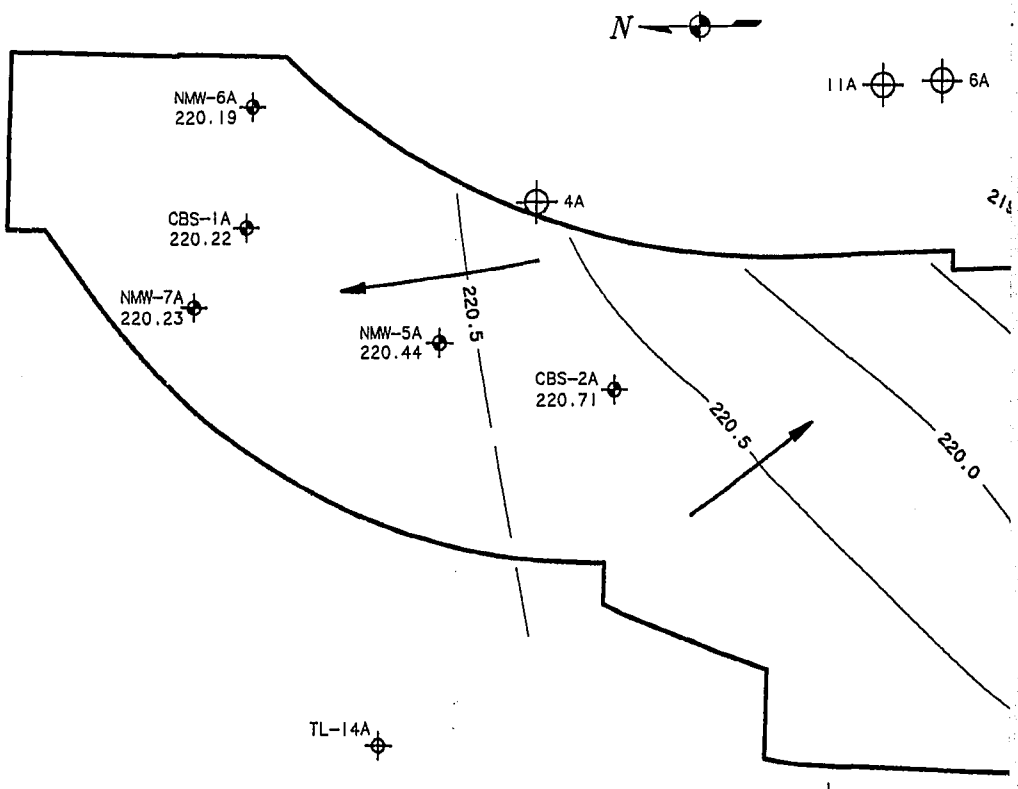
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 7 JUNE 1991

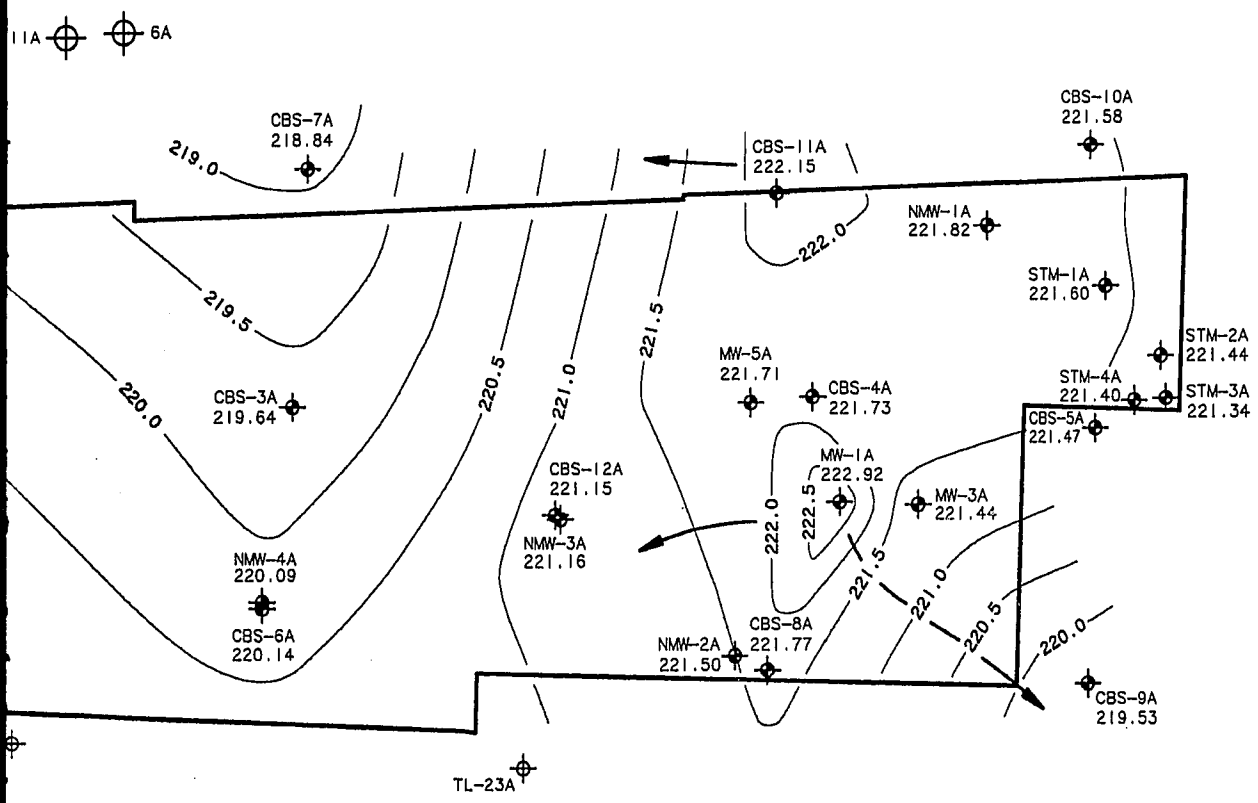
916055.08/P1SK331

FIGURE GW-13



LEGEND

NMW-1A 221.82	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



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SCALE IN FEET

NOTES:

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2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.

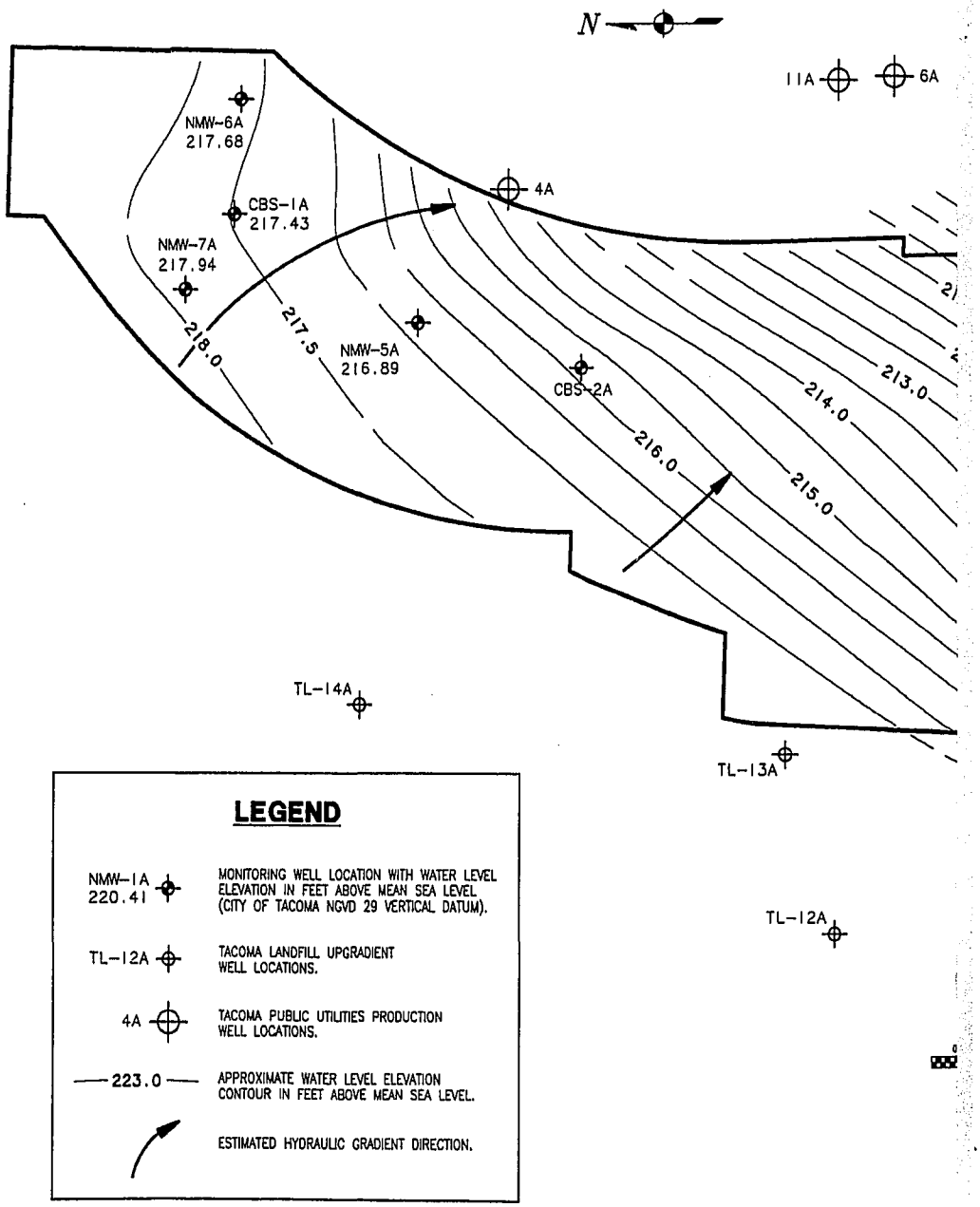
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 11 JULY 1991

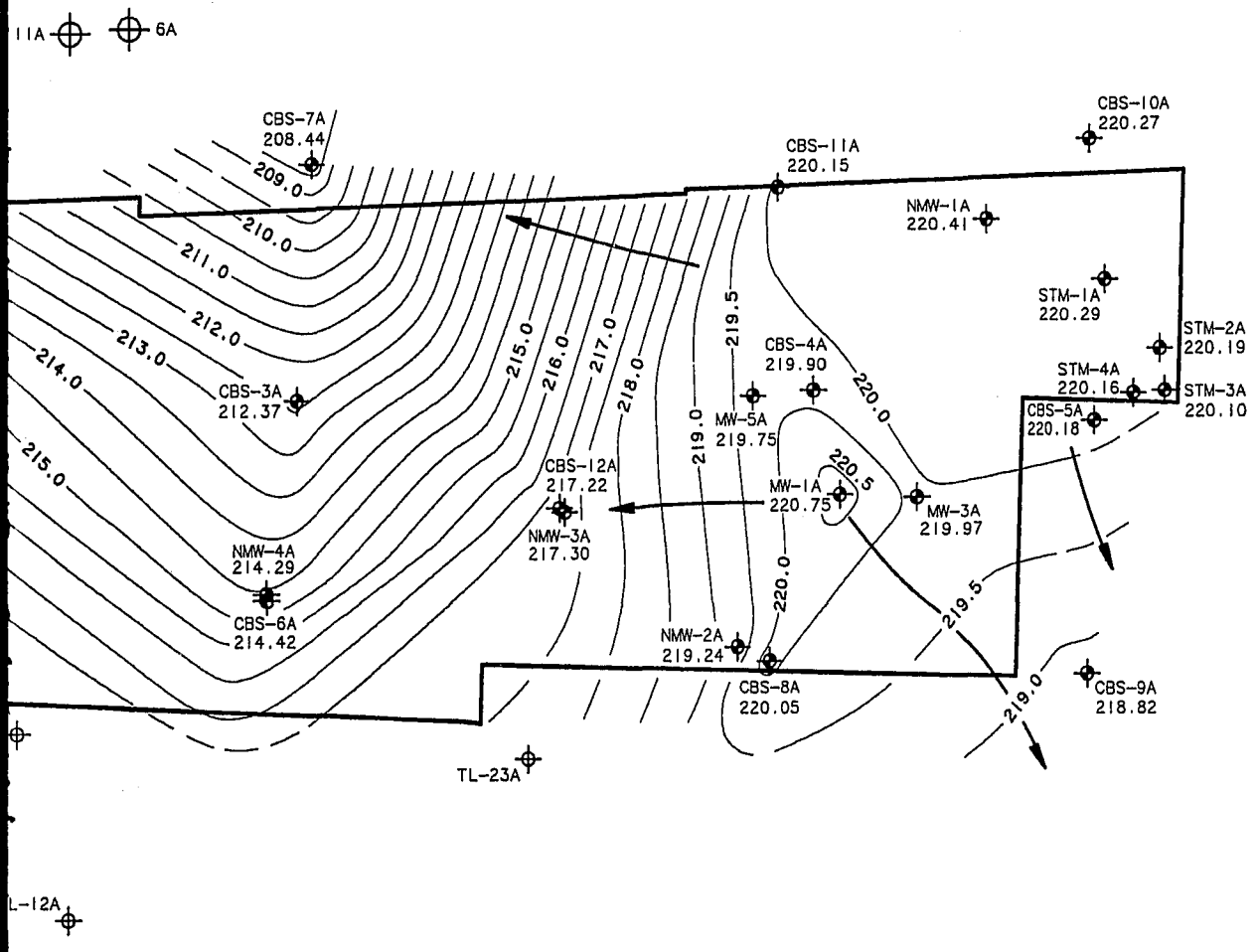
916055.08/P1SK332

FIGURE GW-14



LEGEND

NMW-1A 220.41	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



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SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. CBS-7A WAS DRY DURING THIS MONITORING EVENT. THE ELEVATION OF THE WELL BOTTOM WAS USED AS THE WATER LEVEL ELEVATION.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

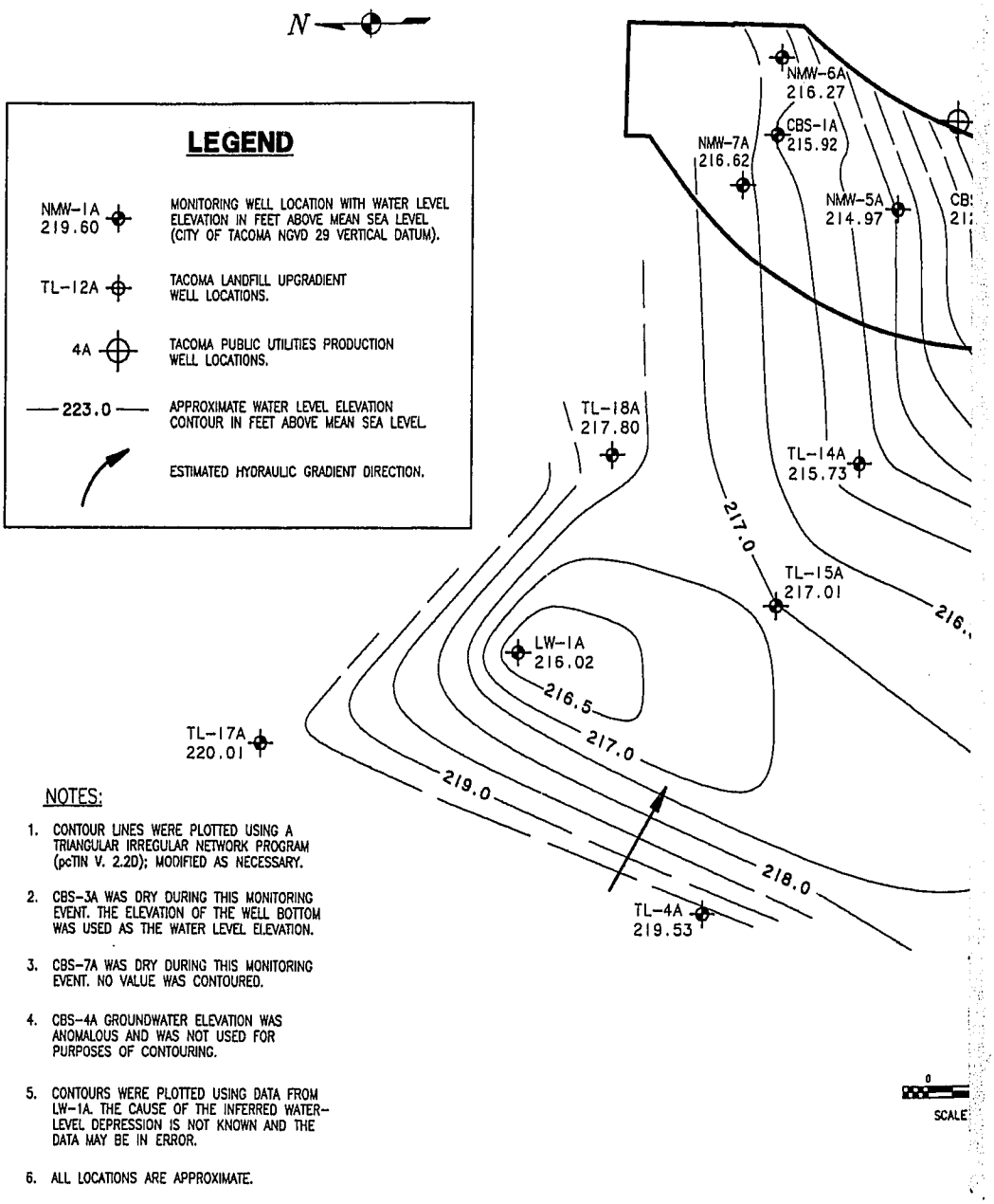
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 8 AUGUST 1991

916055.08/P1SK333

FIGURE GW-15



NOTES:

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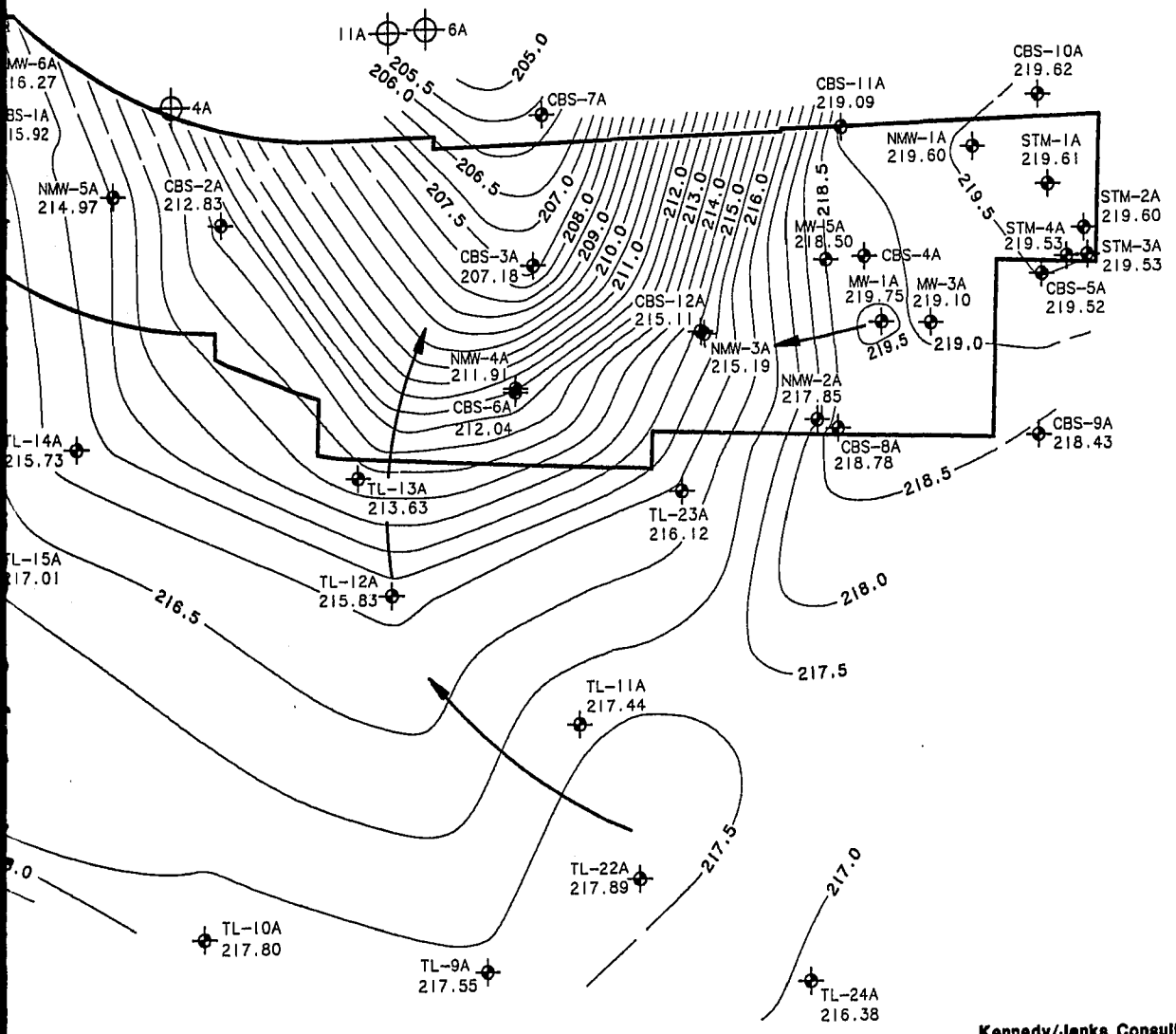
2. CBS-3A WAS DRY DURING THIS MONITORING EVENT. THE ELEVATION OF THE WELL BOTTOM WAS USED AS THE WATER LEVEL ELEVATION.
3. CBS-7A WAS DRY DURING THIS MONITORING EVENT. NO VALUE WAS CONTOURED.
4. CBS-4A GROUNDWATER ELEVATION WAS ANOMALOUS AND WAS NOT USED FOR PURPOSES OF CONTOURING.
5. CONTOURS WERE PLOTTED USING DATA FROM LW-1A. THE CAUSE OF THE INFERRED WATER-LEVEL DEPRESSION IS NOT KNOWN AND THE DATA MAY BE IN ERROR.
6. ALL LOCATIONS ARE APPROXIMATE.
7. ALL CONTOURS ARE INFERRED.



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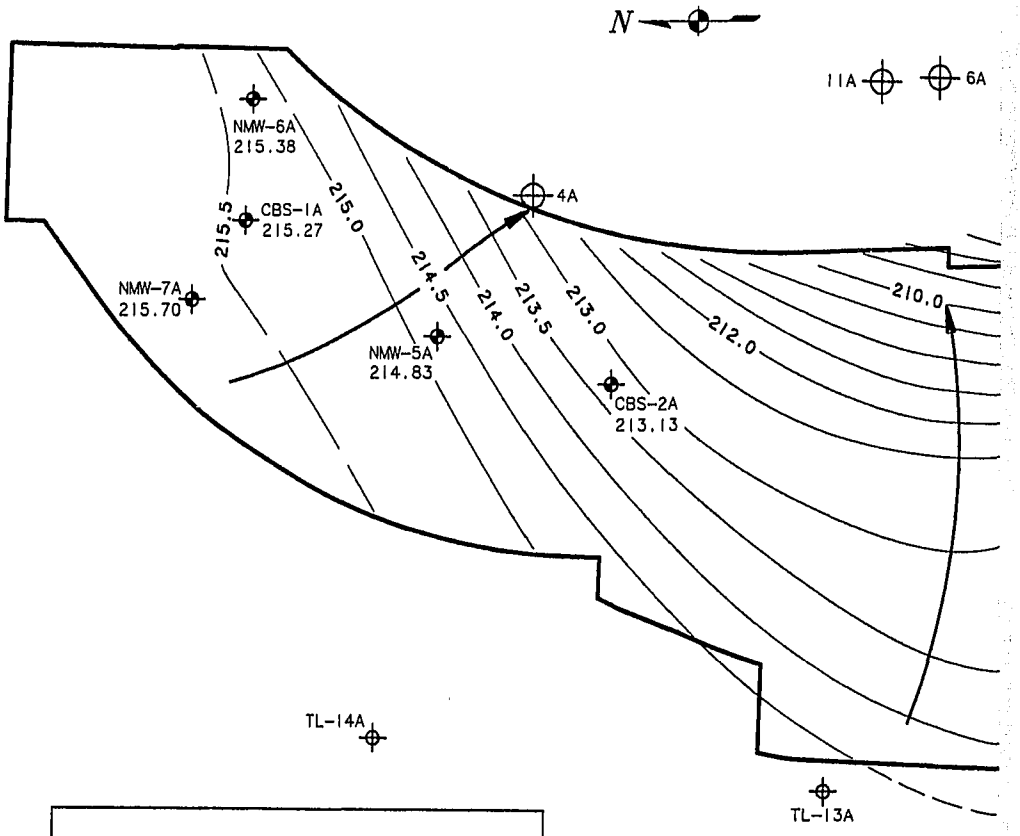
SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 21 & 23 AUGUST 1991

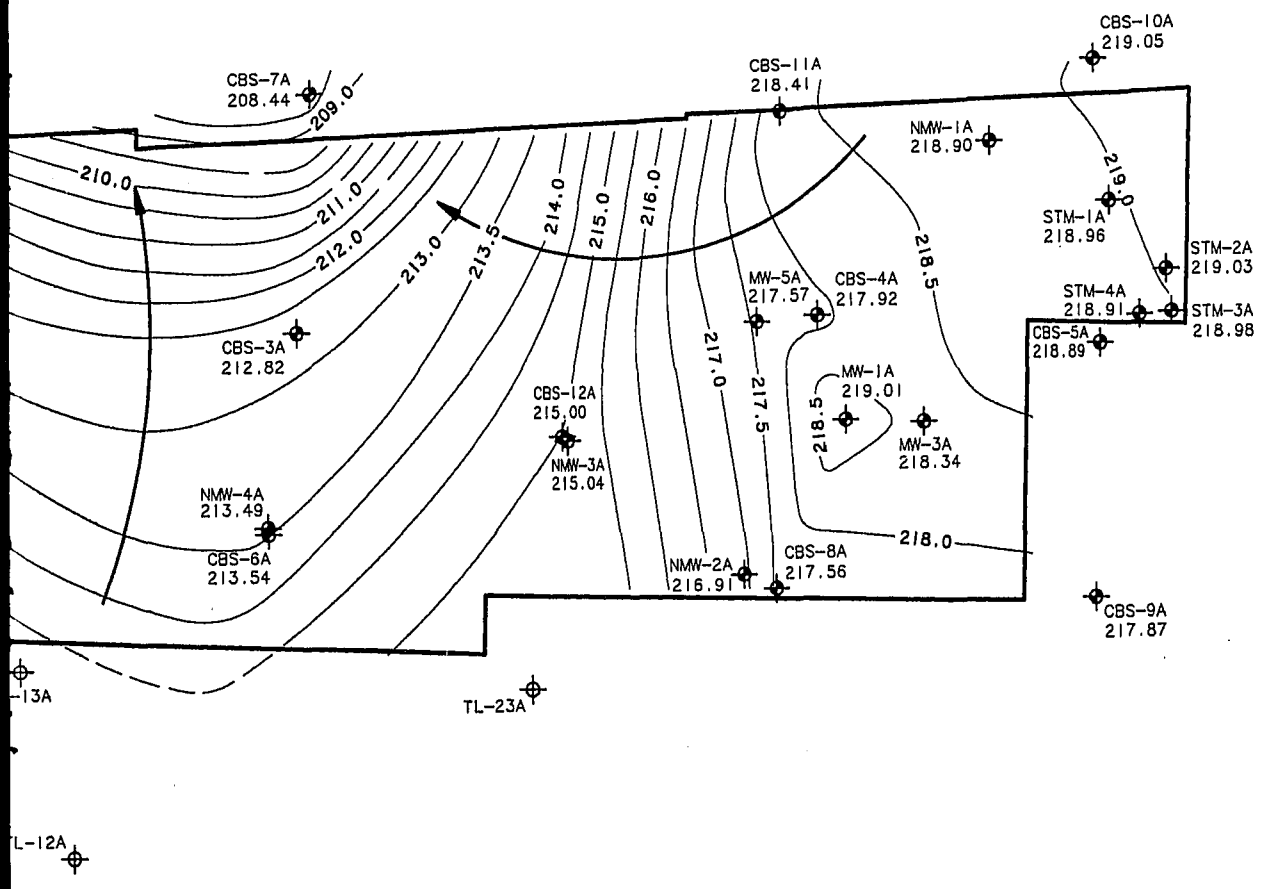
916055.08/P1SK334

FIGURE GW-16



LEGEND

NMW-1A 218.90	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION:



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SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. CBS-7A WAS DRY DURING THIS MONITORING EVENT. THE ELEVATION OF THE WELL BOTTOM WAS USED AS THE WATER LEVEL ELEVATION.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

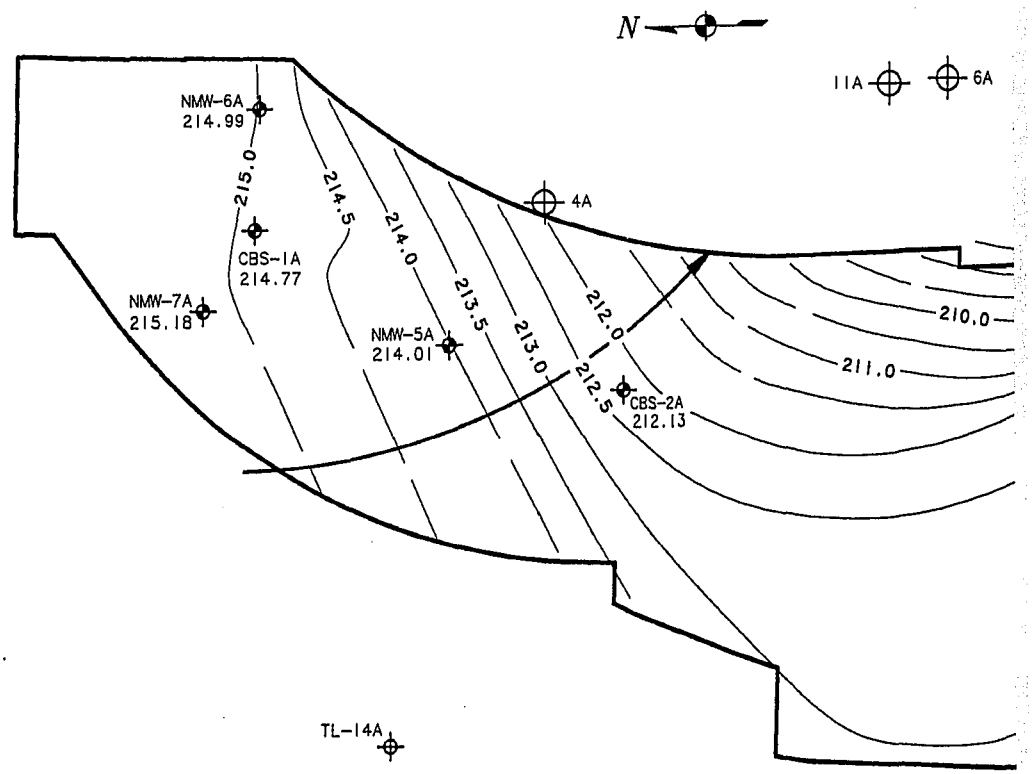
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 9 SEPTEMBER 1991

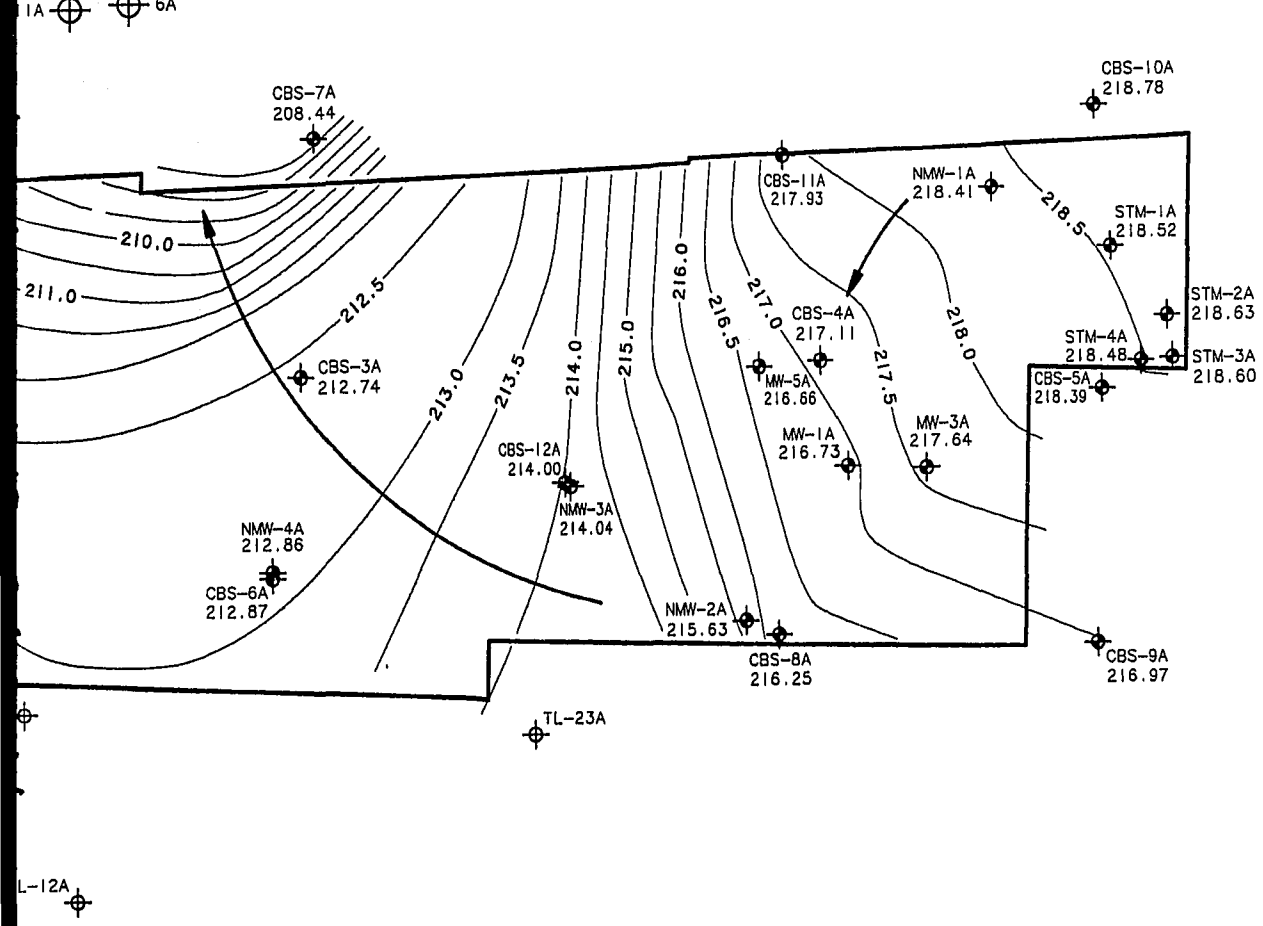
916055.08/P1SK335

FIGURE GW-17



LEGEND

NMW-1A 218.41	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



0 500
SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. CBS-7A WAS DRY DURING THIS MONITORING EVENT. THE ELEVATION OF THE WELL BOTTOM WAS USED AS THE WATER LEVEL ELEVATION.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

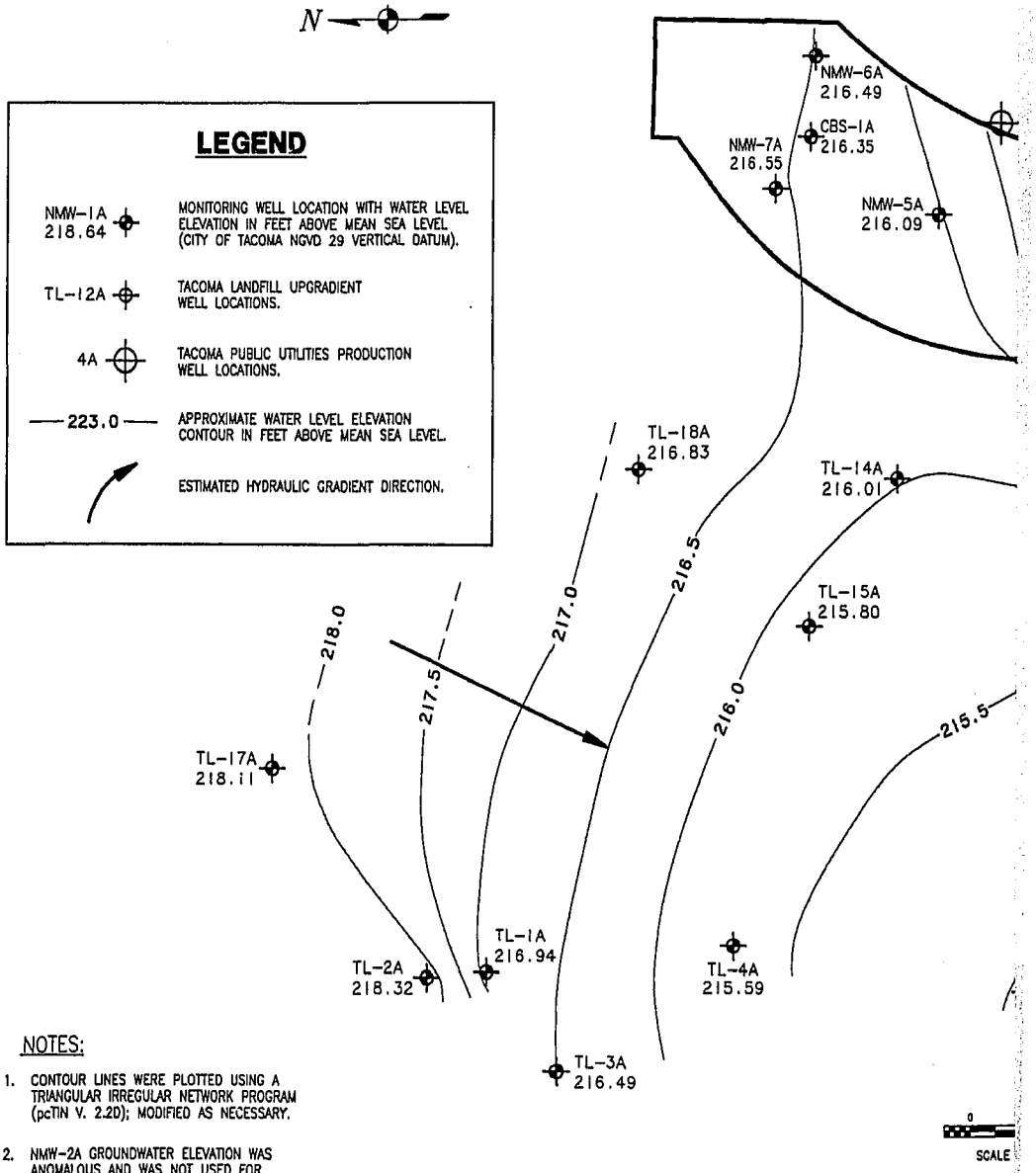
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 17 OCTOBER 1991

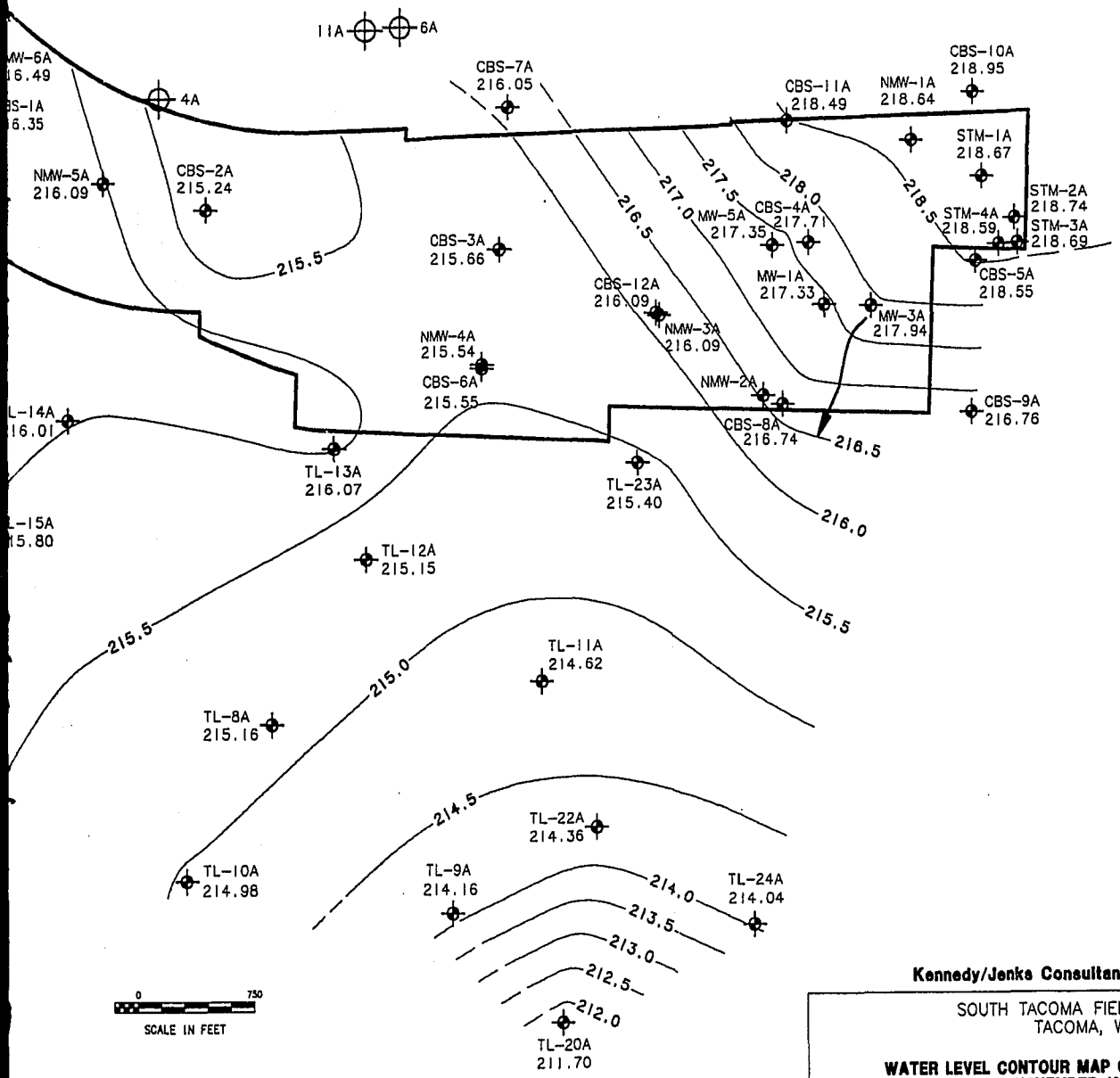
916055.08/P1SK336

FIGURE GW-18



NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.20); MODIFIED AS NECESSARY.
2. NMW-2A GROUNDWATER ELEVATION WAS ANOMALOUS AND WAS NOT USED FOR PURPOSES OF CONTOURING.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.



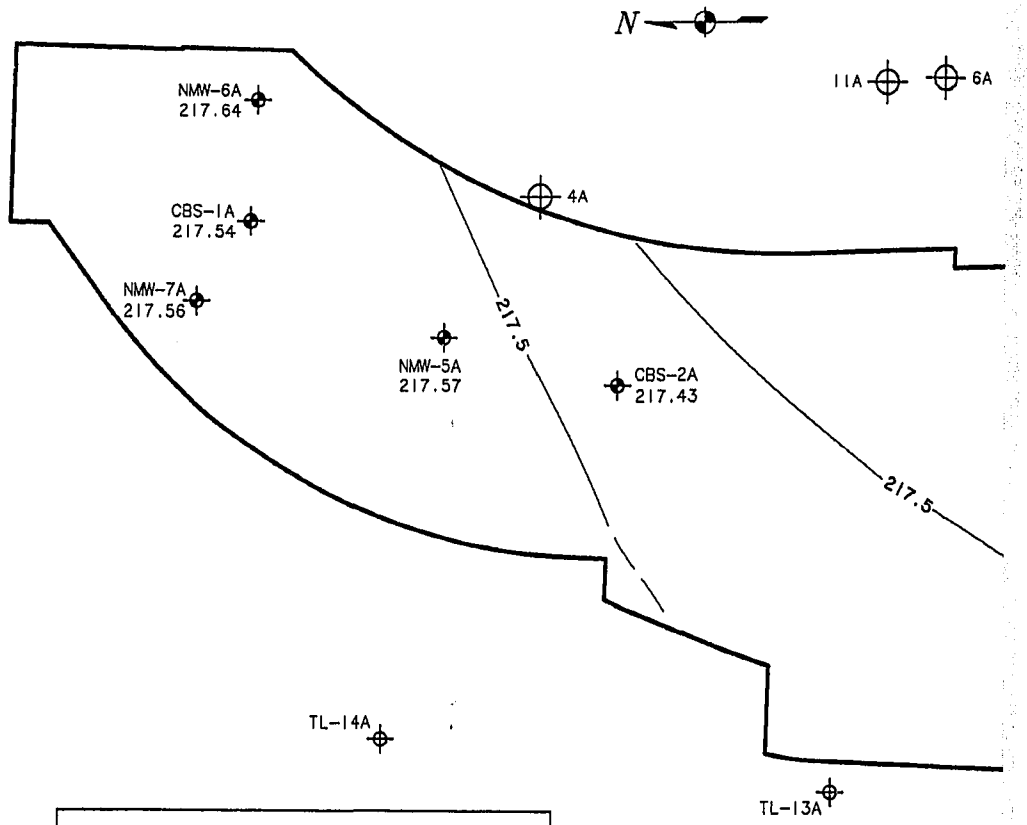
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 5-13 NOVEMBER 1991

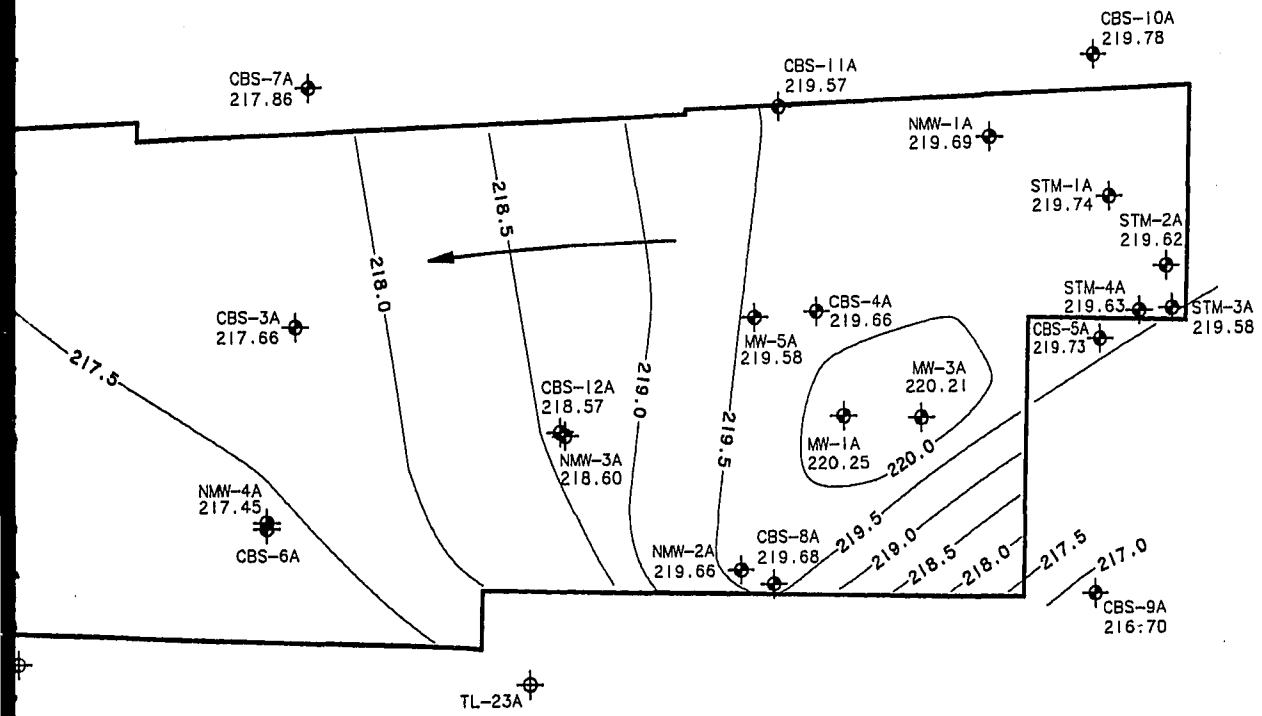
916055.08/P2SK081

FIGURE GW-19



LEGEND

NMW-1A 219.69	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



0 500
SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.20); MODIFIED AS NECESSARY.
2. CBS-6A GROUNDWATER ELEVATION WAS ANOMALOUS AND WAS NOT USED FOR PURPOSES OF CONTOURING.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

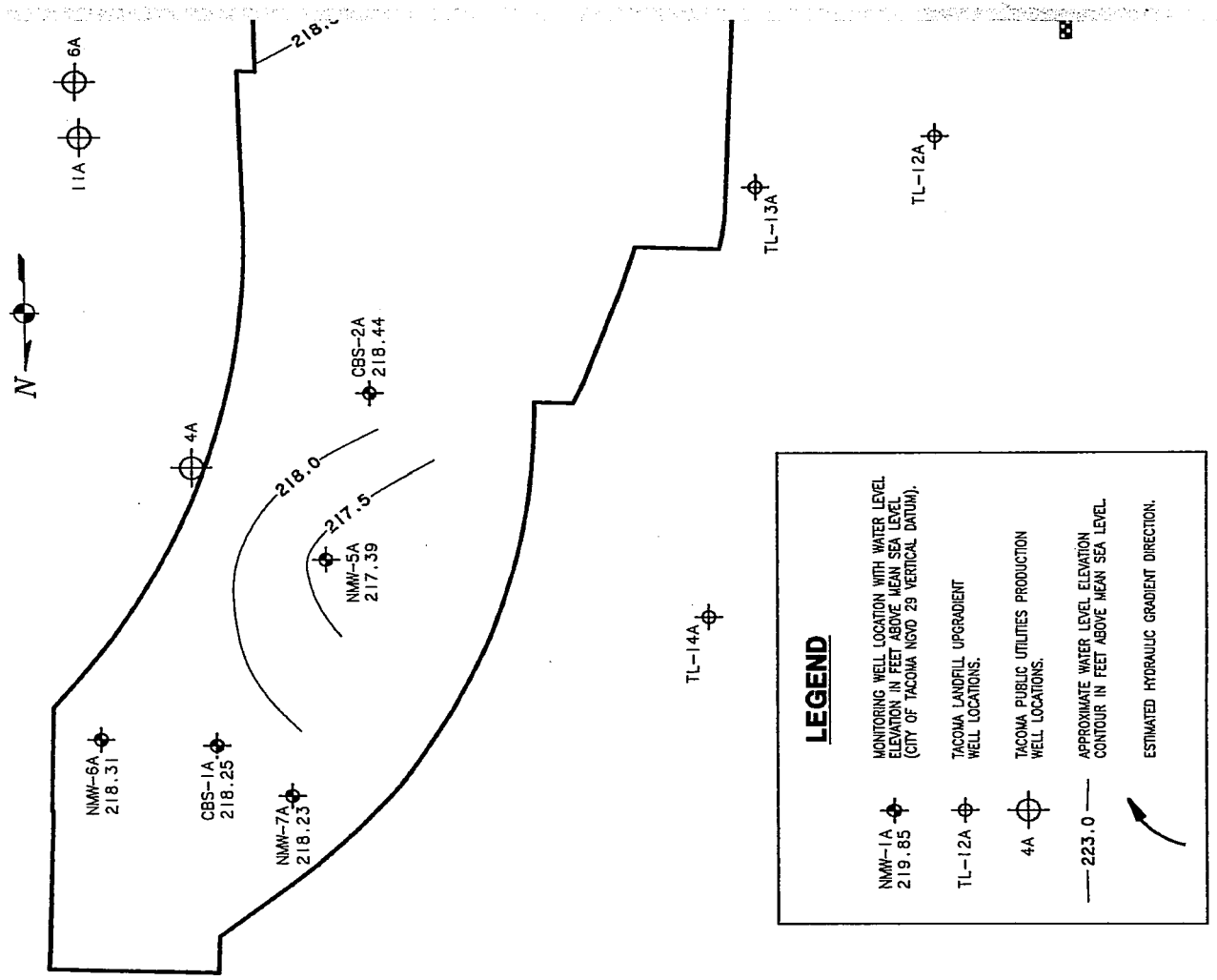
Kennedy/Jenks Consultants

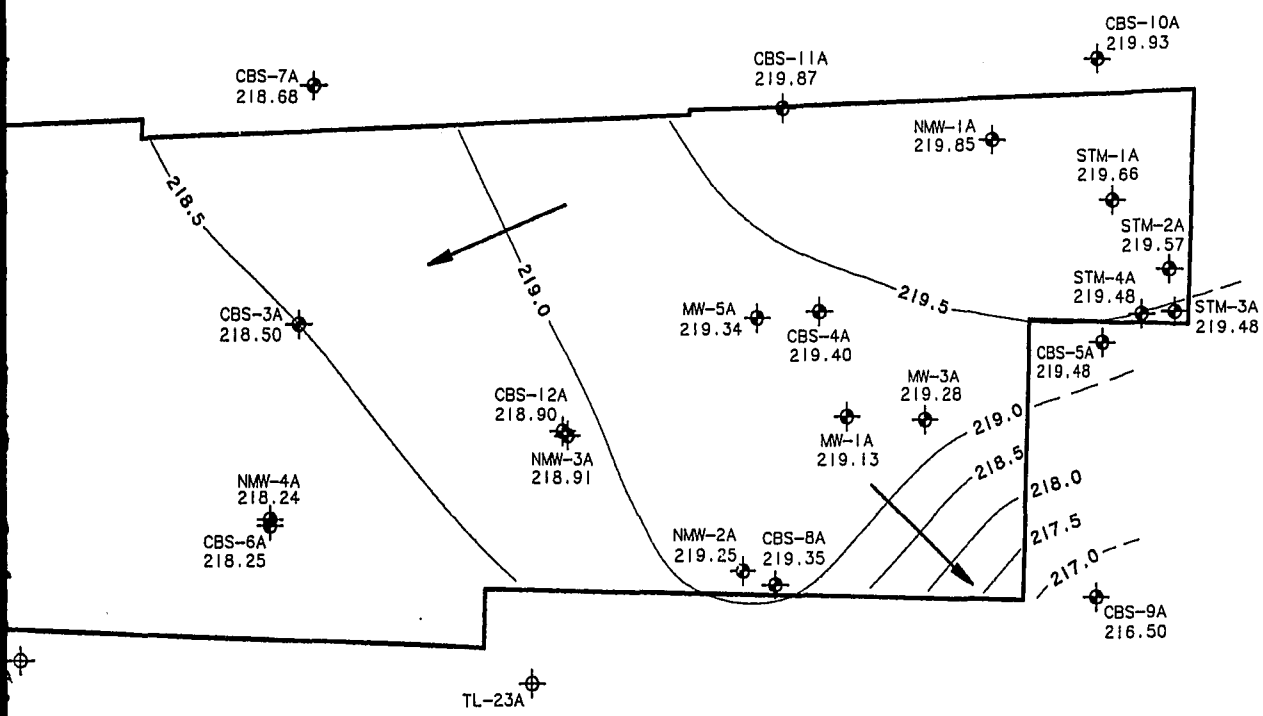
SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 9 DECEMBER 1991

916055.08/P2SK082

FIGURE GW-20





0 500

SCALE IN FEET

NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.2D); MODIFIED AS NECESSARY.
2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.

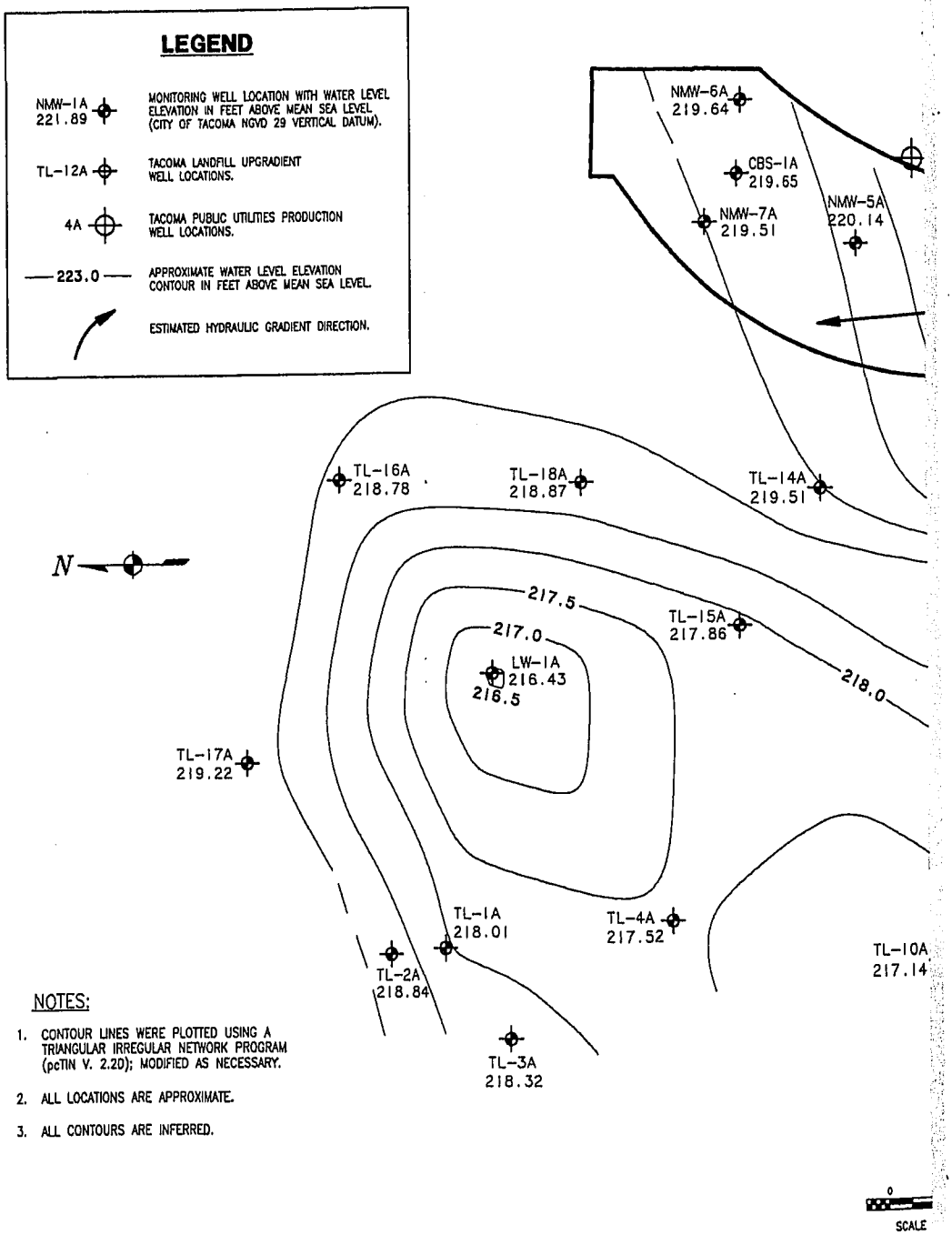
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 7 JANUARY 1992

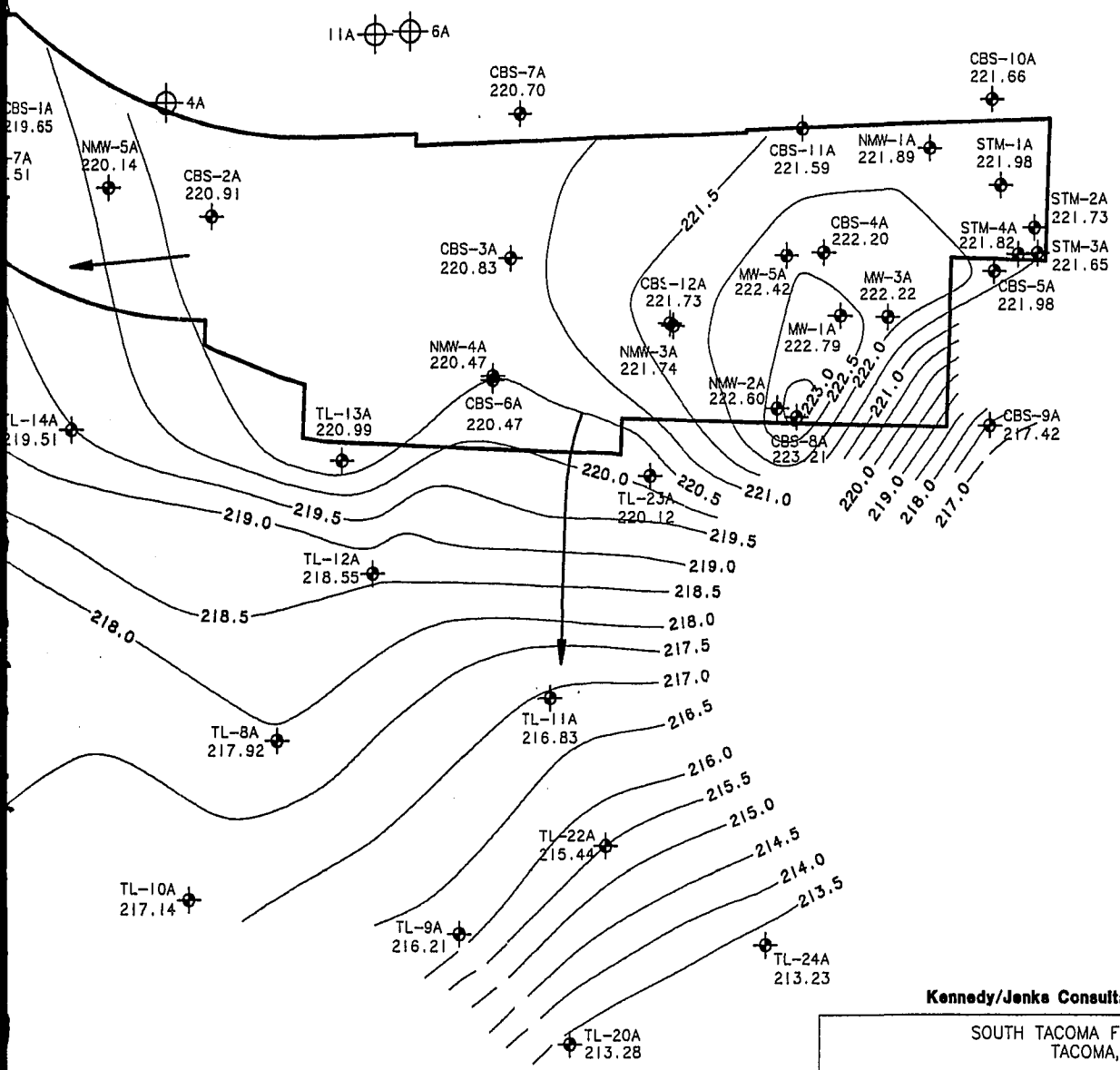
916055.08/P2SK083

FIGURE GW-21



NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.20); MODIFIED AS NECESSARY.
2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.



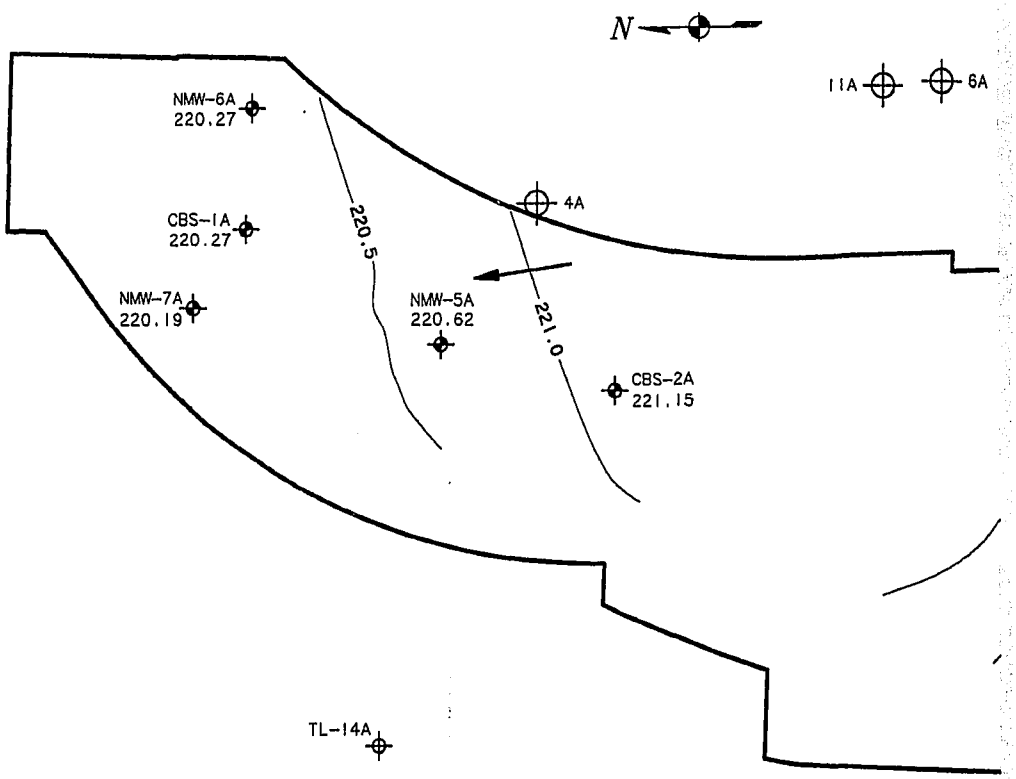
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 3-11 FEBRUARY 1992

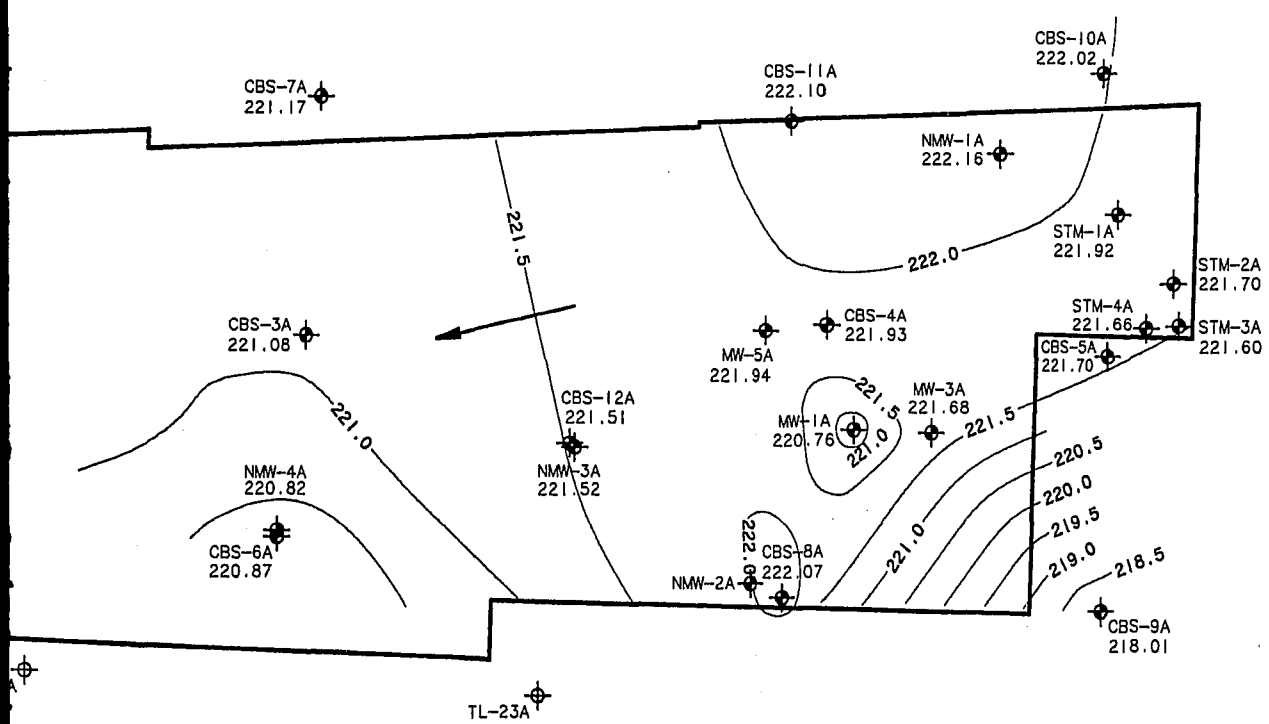
916055.08/P2SK084

FIGURE GW-22



LEGEND

NMW-1A 222.16	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.20); MODIFIED AS NECESSARY.
2. NMW-2A GROUNDWATER ELEVATION WAS ANOMALOUS AND WAS NOT USED FOR PURPOSES OF CONTOURING.
3. ALL LOCATIONS ARE APPROXIMATE.
4. ALL CONTOURS ARE INFERRED.

0 500
SCALE IN FEET

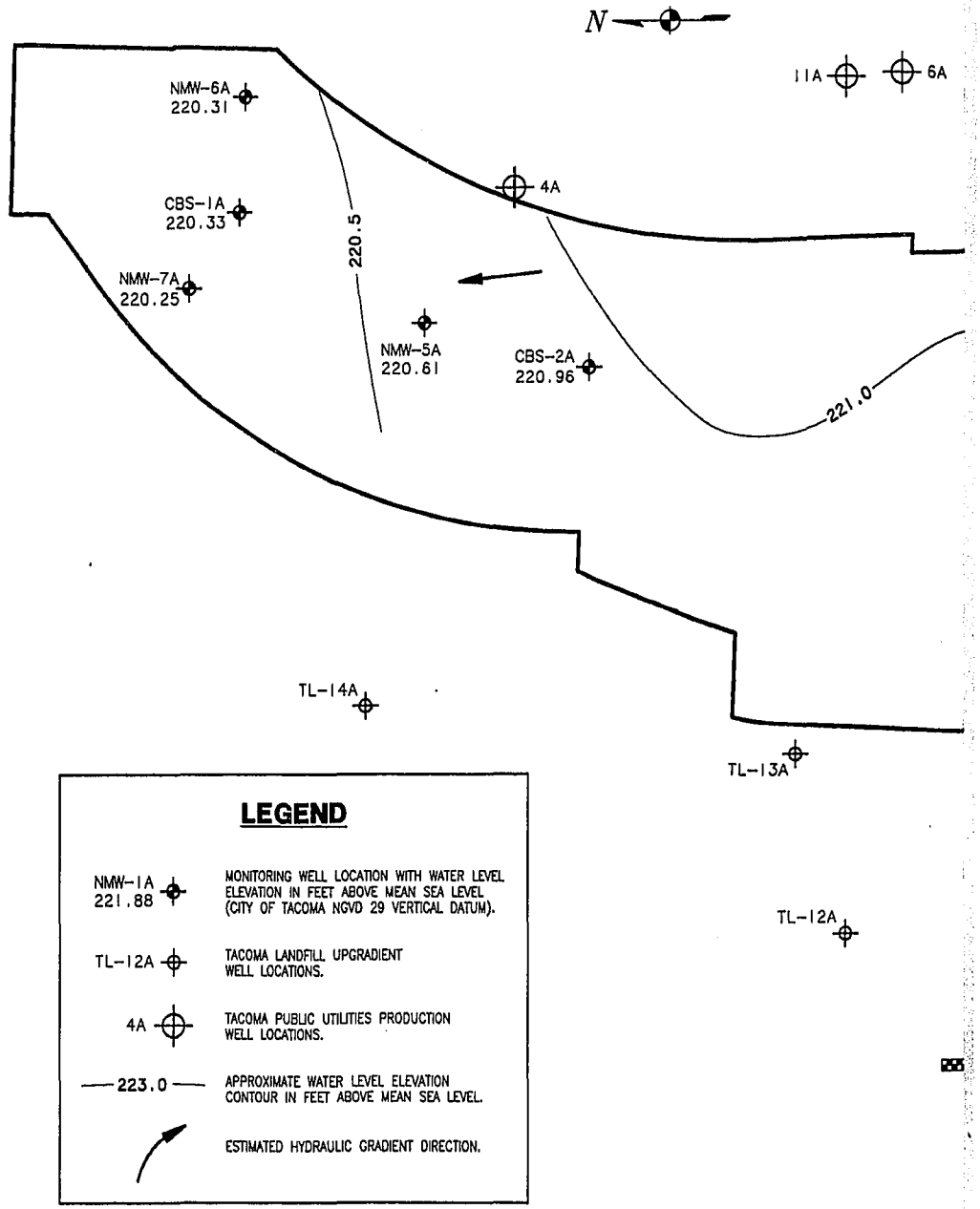
Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 13 MARCH 1992

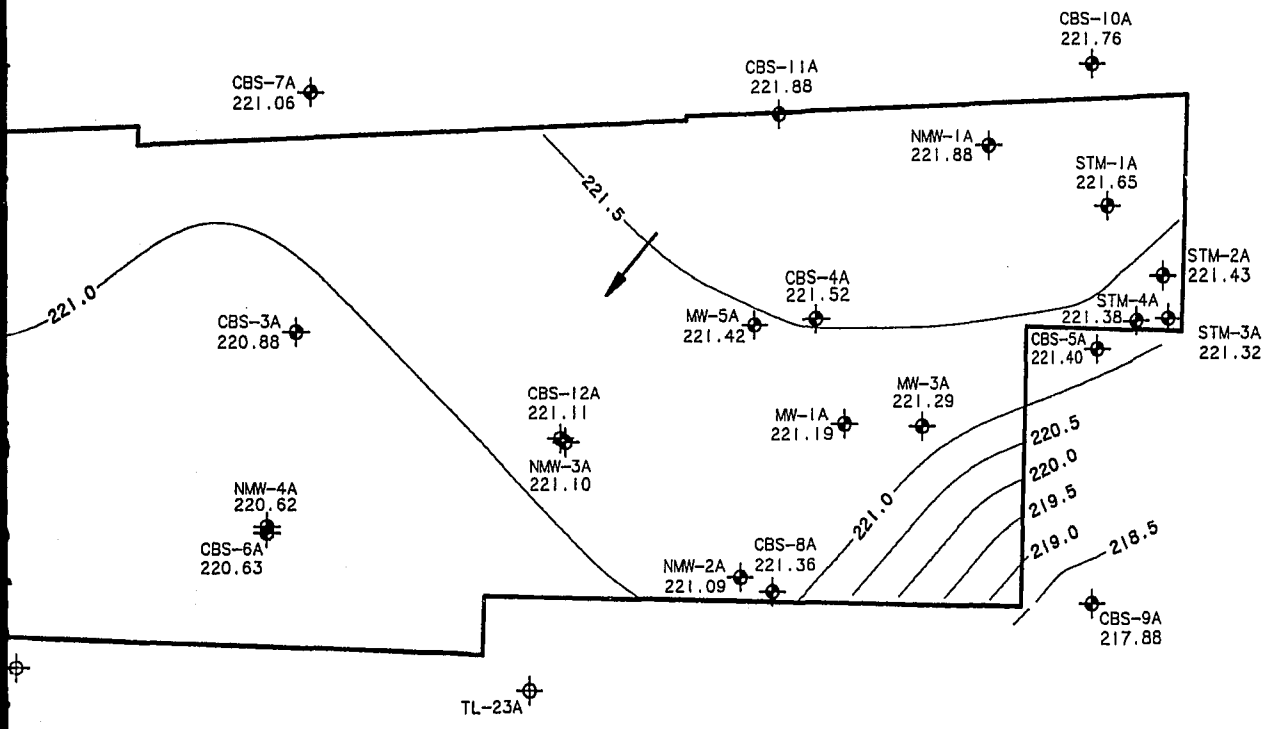
916055.08/P2SK085

FIGURE GW-23



LEGEND

NMW-1A 221.88	MONITORING WELL LOCATION WITH WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL (CITY OF TACOMA NGVD 29 VERTICAL DATUM).
TL-12A	TACOMA LANDFILL UPGRADIENT WELL LOCATIONS.
4A	TACOMA PUBLIC UTILITIES PRODUCTION WELL LOCATIONS.
223.0	APPROXIMATE WATER LEVEL ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL.
	ESTIMATED HYDRAULIC GRADIENT DIRECTION.



NOTES:

1. CONTOUR LINES WERE PLOTTED USING A TRIANGULAR IRREGULAR NETWORK PROGRAM (pcTIN V. 2.20); MODIFIED AS NECESSARY.
2. ALL LOCATIONS ARE APPROXIMATE.
3. ALL CONTOURS ARE INFERRED.

0 500
SCALE IN FEET

Kennedy/Jenks Consultants

SOUTH TACOMA FIELD
TACOMA, WA

WATER LEVEL CONTOUR MAP OF UPPER AQUIFER, 30 MARCH 1992

916055.08/P2SK086

FIGURE GW-24